ELEMENTS OF ANATOMY.

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Sixth Edition

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CONTENTS OF THE SECOND VOLUME.

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MUSCLES.

The structure of the muscular substance having been already given (vol. i.), an anatomical, or a topographical description remains to be added.

The muscles may be arranged in groups from their position in certain regional subdivisions of the body, or from their chief action in the production of the several movements of the body. In the subjoined description they will be divided into regional groups; and in the detail to be furnished respecting each muscle, the following principal points will be considered, viz.: the method of dissecting it or bringing it into view; the end attachments and the connections with surrounding parts; and lastly its action either alone or in union with others of its group.

The muscles are grouped in regions.

Chief points for consideration in each.

EPICRANIAL REGION.

On the roof of the skull there is one muscle on each side, viz. the occipito-frontalis.

*Dissection.**—Care must be taken in making the first incisions which are required to lay bare this muscle, particularly along the vertex; for the tegument is very thick, and at the same time firmly adherent to the thin aponeurosis of the muscle, which is detached with it by almost every beginner: this is the more likely to happen, as the aponeurosis is lifted up from the bone in the effort made to render the tegument tense. The best plan, therefore, is to commence the dissection in such a way as to expose the fleshy fibres of the muscle before and behind; and then, taking these as a guide, and proceeding towards the vertex,

Care necessary in raising the integument.

* The directions for laying bare the different groups of muscles, have been copied from the former edition without very material alteration.

to elevate the tegument from them and from the aponeurosis. Place a high block under the back of the neck, so as to raise the head nearly into the vertical position,—or, if the body be prone, place the block under the chin. Make an incision across the forehead, about an inch above the upper margin of the orbit, and extending from the middle line outwards to the temple. Then a second incision may be carried from the inner termination of the one just indicated, upwards, over the middle of the forehead to the vertex; raise the skin at the angle formed by the junction of these incisions, and cautiously dissect it upwards and outwards, which will expose the fleshy fibres of the frontal part of the muscle. Having proceeded so far at the fore part, make a transverse incision from the occipital protuberance to the root of the mastoid process, a little above, but parallel with the superior curved line of the occipital bone. Another incision may be drawn at right angles with this from the occipital protuberance upwards to the vertex; and from the angle of union of these incisions begin and continue the dissection, raising the skin from the occipital part of the muscle, and so proceeding from the fleshy fibres upwards to the crown of the head. In conducting this dissection, the superficial filaments of the supra-orbital and supra-trochlear nerves will be seen in front; the temporal branches of the portio dura and superior and inferior maxillary at the sides; and the ascending branches of the posterior divisions of the cervical nerves behind; also the branches of the frontal, supra-orbital, temporal, occipital, and posterior auricular arteries. When it is not deemed necessary to retain the large flap of tegument thus dissected off, and reflected down over the ear and side of the neck, it can be readily detached by an incision carried from the outer angle of the orbit backwards to the mastoid process.

Cuts necessary to be made.

Nerves and blood-vessels between integument and the muscle.

Occipito-frontalis; Douglas (epicranius; Albinus).—This is a flat, thin, digastric muscle (fig. 101), extended from the occiput to the forehead (from which circumstance its name is derived), and placed immediately beneath the cranial integument, to which it closely adheres. It rests upon the arch of the skull, over which it slides; and it consists of two broad but short fleshy bellies, united by an intervening aponeurosis.

This is a digastric muscle; and has two muscular parts, and an aponeurosis.

The occipital part.—The posterior fleshy portion is attached, by short tendinous fibres, to the external two-thirds, sometimes much less, of the superior curved line of the occipital bone, and to the mastoid portion of th[e] temporal bone, immediately above the sterno-mastoi[d] muscle. The fleshy fibres, which are from an inch t[o] an inch and a half in length, proceed upwards and in[-]wards, and terminate in distinct white tendinous fibre[s] which soon become continuous with the aponeurosis. Betwe[en] the occipital portions of opposite sides of the head there i[s] considerable, but in different cases a varying intersp[ace] which is occupied by the epicranial aponeurosis.

Occipital part; connection with bone; and tendon; interval between both occipital parts.

Frontal part.

larger than occipital,

blends with other muscles below.

Frontal part.—The fleshy fasciculi of which this portion of the muscle is composed, extend downwards and forwards on the frontal bone: they are longer and broader than those of the occipital part, but the fibres are paler and less distinctly muscular; their upper ends being their junction with the aponeurosis, present a curved line, which is a little below the coronal suture. The inner fibres, corresponding with the median line, descend vertically, and are continuous with the pyramidalis nasi;[3] the middle fibres, longer than the others, terminate by being blended with the orbicularis[2], and corrugator supercilii; and the external fibres curve somewhat inwards, and become blended with those of the orbicularis palpebrarum over the external angular process of the frontal bone. The inner margins of the right and left frontal portions are united together for some space above the root of the nose.

Fig. 101.*

Both frontal parts join.

Aponeurosis,

connects the muscles;

The *aponeurosis* of the occipito-frontalis (membrana epicrania; galea aponeurotica capitis) extends over the upper surface of the cranium uniformly from side to side, without any separation into lateral parts. It must therefore be regarded as a single structure, having connected with it the occipital and frontal muscular strata above described; and at the same time uniting the muscles of opposite sides, and combining them in action.

attached to occipital bone behind;

Posteriorly in the interval between the occipital parts of the muscles, the aponeurosis is fixed to the occipital pro-

* 1. Occipito-frontalis. 2. Orbicularis palpebrarum. 3. Pyramidalis nasi. 4. Compressor naris. 5. Levator labii superioris et alæ nasi. 6. Levator labii superioris. 7. Levator anguli oris. 8. Zygomaticus minor. 9. Zygomaticus major. 10. Depressor anguli oris. 11. Depressor labii inferioris. 12. Levator menti. 13, points to the buccinator. 14. Orbicularis oris. 15. Masseter. 16, 17, 18. Superior, posterior, and anterior auricular. 19. Platysma myoides.

tuberance, and to the curved line above the insertion of the trapezius; in front, it presents in the middle an angular elongation, which intervenes for a short distance between the margins of the frontal portions; laterally, it has connected with it the superior and anterior auricular muscles. In the situation of the temporal ridge it loses the aponeurotic character, and is continued over the temporal fascia to the zygoma by a layer of laminated connective tissue. Its fibres are chiefly longitudinal, following the direction of the muscular fibres; and they will be found distinctly tendinous where they are joined by the occipital portions of the muscles.

laterally to side of the skull.

Connected closely with integument; loosely with pericranium:

The aponeurosis is firmly connected with the skin and subcutaneous granular fat (in which several blood-vessels and nerves ramify) by numerous short fibrous bands; and it adheres loosely to the subjacent pericranium, through the medium of thin connective tissue devoid of fat. Hence the muscles, when thrown into action, move the hairy scalp and the aponeurosis on the immediate investment of the skull; but whilst these two parts, when united together, admit of being easily and speedily stripped from the skull, the skin cannot be separated from the muscle with facility. The integument is likewise closely connected with the frontal portion of the muscle, and the skin of the forehead is, in consequence, folded or wrinkled when this contracts.

so the scalp is moved.

Some anatomists consider the whole to be a four-headed muscle, having two fleshy portions behind, and two in front, all connected by a single layer of aponeurosis which rests on the cranium. Others view it in a different way, and consider the fleshy parts to form two separate muscles on each side, which have been named from their position—the anterior, the "frontal" muscle, the posterior, the "occipital."

Action on the eyebrows and skin of the forehead.

Actions.—All the muscular parts having one broad common aponeurosis, they act together: their first effect is to draw up the eyebrows; the next to throw the skin of the forehead into transverse folds or wrinkles; and the last, to move the hairy scalp backwards and forwards, by bringing the occipital and frontal parts of the muscle alternately into action.

MUSCLES OF THE FACE AND SIDE OF THE HEAD.

Division into regions.

The muscles of the face and side of the head are easil[y] and conveniently arranged in groups, each of which occupi[es] a so-called region. The circumference of the orbit with t[he] eyebrow and eyelids forms the palpebral region; the side

the nose—the nasal; the cheek or side-face—the superior maxillary; the circumference of the mouth, and the space between the jaws—the intermaxillary; and the part corresponding with the lower jaw—the inferior maxillary. The interior of the orbit forms a separate region—the orbital; so does the space round the ear—the auricular; and that of the temple and side of the jaw,—the temporo-maxillary; finally, there is the region of the pterygo-maxillary fossa.

In consequence of their position, and their connection with the aponeurosis of the occipito-frontalis, the muscles of the ear will be first examined.

AURICULAR REGION.

In the space round the external ear are three small muscles, which in the human body may be considered rudimentary. They are attached by small tendons to the cartilage of the ear, and are quite superficial.

Auricular muscles rudimentary.

Dissection.—These muscles are generally removed together with the skin, when their dissection is attempted in the usual way by the beginner, who seeks to expose the fleshy part first: better at once reverse the process—seek for the tendons, and take them as guides. For this purpose, draw the pinna or broad part of the ear downwards; a very small tense cord will be felt under the skin, where it is reflected from the head to the ear, running from above downwards to the upper bulging part of the concha. This is the tendon of the attollens. Cautiously divide the skin by an incision drawn over the tendon from below upwards; reflect it to each side, and continue the process thus upwards from the tendon to its muscular fibres, which spread upon the temporal fascia. Proceed in the same way to see the two other muscles—draw the pinna forwards, and the prominence of the retrahens will be readily perceived where it is inserted into the bulging part of the concha behind. Let a hook be inserted into the extremity of the helix at the point corresponding with the line of the zygoma. When the helix is drawn backwards, the tendon of the attrahens muscle is rendered tense, and can be exposed and dissected as in the previous instances.

How to dissect them.

The *superior auricular* (fig. 101,[16]) (attollens auriculam; Alb.—temporo-auricularis,) is the largest. It arises from the aponeurosis of the occipito-frontalis, where this expands on the side of the head; its fibres are delicate, and radiated. The muscle ends in a compressed tendon, which is inserted into the upper and anterior part of the cartilage of the ear, into the outer side of the fossa at the front of the antihelix.

Superior auricular; how attached above, and below.

Posterior auricular[17] (retrahentes auriculam (tres); Alb.—mastoido auricularis).—The muscle consists of two or three

Posterior auricular,

are well developed. These parts have been described as two muscles; the former being named "ciliaris," the latter "orbicularis latus."*

Tendon of the muscle,

The *tendon* of the muscle (tendo palpebrarum).—At the inner commissure of the eyelids is a small tendon, which is often obscured by the fibres of the muscle, but is rendered apparent by drawing the lids outwards. This tendon is about two lines in length, and one in breadth, and is attached to the anterior margin of the lachrymal groove; thence it runs horizontally outwards to the inner commissure of the eyelids, where it divides into two thin fibrous lamellæ, which diverge as they pass outwards in the substance of the eyelids, and terminate in the tarsal cartilages. One surface of the tendon is subcutaneous; the other crosses the lachrymal sac a little above the centre, and from it a thin but firm fascia is given off, which spreads over the lachrymal sac, and adheres to the margins of the groove which lodges it.

serves as a ligament to the lids.

Corrugator supercilii, its position,

The *corrugator supercilii* (fronto-superciliaris) is a small pyramidal muscle, placed in the eyebrow, whose direction it takes, and is altogether concealed by the orbicularis palpebrarum and occipito-frontalis. It arises from the inner extremity of the superciliary ridge of the frontal bone; from which its fibres proceed outwards and a little upwards, and end, at the middle of the orbital arch, by becoming blended with those of the orbicularis and occipito-frontalis. Its anterior surface is covered by the muscles just named; the posterior rests upon the frontal bone, and crosses the supratrochlear branch of the ophthalmic nerve and the accompanying artery as they emerge from the orbit.

origin, and ending.

Levator palpebræ;

Levator palpebræ (fig. 105,[1]) (orbito-palpebralis).—This slender muscle is contained, in the greater part of its extent, within the orbit. It arises above and before the margin of the optic foramen, from which it passes forwards mounting over the globe of the eye, and separated from the roof of th[e] orbit only by the fourth and frontal nerves. Very narro[w] and tendinous at its origin, it soon becomes fleshy a[nd] widens; and finally ends in a broad fibrous expansi[on] which curves downwards in the substance of the upper eyel[id] to be inserted into the forepart of the tarsal cartilage. Th[is] muscle lies above the rectus superior and the ball of the ey[e], and, in the lid, it is placed between the palpebral ligam[ent] and the mucous membrane (conjunctiva).

in the orbit and eyelid;

inserted into superior tarsal cartilage.

* This division is mentioned by Riolanus as usual amon[g] anatomical writers of his time.—"Anthropologia," lib. 5, cap. 1[...]

The *tensor tarsi*—Horner, (musculus sacci lachrymalis,)—is a very thin, small muscle, placed at the inner side of the orbit, behind the tendon of the orbicularis, and resting against the fibrous covering of the lachrymal sac. Its fibres arise from the posterior part of the lachrymal bone, and as they pass outwards they divide into two narrow processes; these diverge, cover the lachrymal canals, and become attached to the inner ends of the tarsal cartilages. Tensor tarsi. Attachment.

This little muscle has been described as an offset of the ciliaris of the lids, with which the fibres appear to be continuous (Theile, Op. citat.).—It is often indistinct.

Actions.—The corrugator muscle, being fixed by its inner extremity, draws upon the eyebrow and throws the skin into perpendicular lines or folds, as in frowning. The occipito-frontalis will, on the contrary, elevate the brow, and wrinkle the skin transversely; which actions are so frequently repeated by most persons, and so constantly by some of a particular temperament, that the skin is marked permanently by lines in the situations just referred to. The orbicular muscle is the sphincter of the eyelids. It closes them firmly, and at the same time draws them towards the inner angle of the orbit, which is its fixed point of attachment. The levator palpebræ is the direct antagonist of the orbicular muscle; for it raises the upper eyelid, and uncovers the globe of the eye. The tensor tarsi draws the eyelids towards the nose, and presses the orifices of the lachrymal ducts closely to the surface of the globe of the eye. It may thus facilitate the entrance of the tears into the ducts, and promote their passage towards the nose. Action of corrugator supercilii; of orbicularis palpebrarum. Levator palpebræ. Tensor tarsi.

NASAL REGION.

The several muscles of the nose are as follows:—

Pyramidalis nasi (figs. 101,[3] and 102,[1]) (naso-frontalis) rests on the nasal bone, and appears like a prolongation of the occipito-frontalis, with whose fibres it is intimately connected, as well as with those of the corresponding muscle. It extends from the root of the nose, where its fibres are continuous with the occipito-frontalis, to about half-way down, where it becomes tendinous and unites with the compressor naris. The two pyramidal muscles diverge as they descend, leaving an angular interval between them, and each terminates in a thin fibrous lamella, which covers the Pyramidalis nasi, is continuous with occipito-frontalis, and ends on the nose.

side of the nose. This muscle is covered by the common tegument, and rests upon the nasal eminence of the frontal bone and the os nasi.

Its chief use seems to be that of giving a fixed point for the action of the occipito-frontalis muscle; it also wrinkles the skin at the root of the nose.

Levator communis.

The *levator labii superioris alæque nasi* (figs. 101,[3] and 102,[2]) (common elevator of the lip and nose) lies along the side of the nose, extending from the inner margin of the orbit to the upper lip. It *arises* by a pointed process from the upper extremity of the nasal process of the superior maxillary bone, and, as it descends, separates into two fasciculi; one of these, much smaller than the other, becomes attached to the wing of the nose, whilst the other is prolonged to the upper lip, where it is blended with the orbicularis and the special elevator muscle. It is subcutaneous, except at its origin, where the orbicularis palpebrarum overlaps it a little.

Musculus anomalus, or rhomboideus.

Beneath the common elevator of the lip and ala of the nose, and connected by the lower end with the origin of the next muscle, the compressor naris, will be found a longitudinal muscular slip, more than an inch in length, attached exclusively to the superior maxillary bone. It was named "rhomboideus" by Santorini, and (in consequence of being attached only to one bone, and having therefore no action), "anomalus" by Albinus.

Compressor naris is triangular; its fibres transverse. Origin.

Compressor naris (figs. 101,[4] and 102,[3]) (transversalis v. triangularis nasi).—This is a thin, small, triangular muscle, which lies close upon the superior maxilla and the side of the nose, the direction of its fibres being transverse from without inwards; it is concealed at its origin by the proper elevator of the lip, and is crossed by the common elevator. It *arises* narrow and fleshy from the canine fossa in the superior maxillary bone, from which its fibres proceed inwards, gradually expanding into a thin aponeurosis, which is partly blended with that of the corresponding muscle of the opposite side, and of the pyramidalis nasi, and is partly attached to the cartilage of the nose.

Depressor alæ nasi: its attachments.

The *depressor alæ nasi* is a small flat muscle, lying between the mucous membrane and the muscular structure of the lip, with which its fibres are closely connected. From a depression (myrtiform) near the alveolar border of the superior maxilla, the fibres ascend to terminate in th[e] septum and the posterior part of the ala of the no[se]

(fig. 102,[6]). The external fibres curve forwards and downwards to the ala.

Besides the muscles above described, there are other muscular fibres which cover the small cartilages of the nose. They are usually very indistinct; partly in consequence of the close connection of the skin with the cartilages of the nose, between which they lie; and the necessary removal of a portion of their fibres when the skin to which they are attached is cut away. The muscular fibres admit of being divided into two distinct parts, as follows:— **Muscles acting on the apertures of the nose.**

Fig. 102.*

Levator proprius alæ nasi posterior (dilatator naris poster.) (fig. 102,[5]).—After the careful removal of the common elevator of the nose and lip, this muscle will be sometimes apparent to the naked eye, but generally with the aid of a lens. (Theile.)—Its fibres are attached to the margin of the mounting process of the superior maxillary bone, and the smaller (sesamoid) cartilages of the ala nasi on the one hand, and to the skin on the other.— **Levator alæ nasi proprius posterior,**

The anterior set of fibres (*lev. propr. alæ nasi anterior* v. dilatator naris anterior) (fig. 102,[4]) are interposed between the cartilage of the aperture of the nose and the skin, to both of which they are attached.† **and anterior.**

* Represents the muscles of the nasal region, with some of those of the lip. 1. Pyramidalis nasi. 2. Levator labii superioris alæque nasi. 3. Compressor naris. 4. Levator proprius alæ nasi anterior. 5. Levator proprius alæ nasi posterior. 6. Depressor alæ nasi. 7. Orbicularis. 7*. Nasolabialis.

† The muscular structure here described, or a great part of it, has been described and delineated under the name "pinnæ dilatator" by Santorini.—(Obs. Anat., cap. 1, § 14, and tab. 1.) But in recent observations two separate muscles (noticed in the text) have been recognised by Professor Theile, in the new ed. of "Sömmerring v. Baue d. menschlich. Körpers." M. Arnold (Tab. Anat., fascic. 2, tab. 8, figs. 6 and 7) apparently connects the posterior muscle with the depressor alæ nasi, describing both as one large "dilatator."

SUPERIOR MAXILLARY REGION.

In this group are four muscles, viz. the elevator of the upper lip, the elevator of the angle of the mouth, and the two zygomatici.

Levator labii superioris, The *levator labii superioris* (fig. 101,[6]) (the proper elevator of the upper lip) extends from the lower border of the orbit to the upper lip, lying close to the outer border of the common elevator, with which and the smaller zygomatic muscle it is blended inferiorly. origin, covers infra-orbital foramen. It *arises* immediately above the infra-orbital foramen, where its fibres are attached partly to the superior maxillary bone, partly to the malar. Its direction is downwards and a little inwards to the upper lip, where it unites with the rest of the muscular substance of that part. At its origin this muscle is overlapped by the orbicularis palpebrarum, but its lower part is subcutaneous; it partly conceals the levator anguli oris, and the compressor naris.

Levator anguli oris. *Levator anguli oris* (fig. 101,[7]) (musculus caninus).—The elevator of the angle of the mouth lies beneath the preceding, and is partly concealed by it. Origin and insertion. It *arises* immediately below the infra-orbital foramen, from the canine fossa, whence the name *caninus*, and is inserted into the angle of the mouth. It is broader above than below, and inclines outwards somewhat as it descends: it lies at the middle of the face, deeply behind the outer border of the elevator of the upper lip, and escapes from under this at the lower end, in consequence of the different direction of the two muscles. Connections. Its anterior surface supports the infra-orbital nerve and artery, which separate it from the preceding muscle; the posterior lies on the superior maxilla and the orbicularis and buccinator muscles, with which and the depressor anguli oris the fibres are blended.

Zygomatici muscles. The *zygomatici* are two narrow fasciculi of muscular fibres, extending obliquely from the most prominent point of the cheek to the angle of the mouth, one being larger and longer than the other.

Zygomaticus minor joins levator labii; *Zygomaticus minor* (fig. 101,[8]). This irregular littl muscle *arises* from the anterior and inferior part of th malar bone, and inclines downwards and forwards to ter minate by joining with the outer margin of the levator lab' superioris; the junction sometimes occurring close to t' connection origin of the zygomaticus minor. It lies internal to t

succeeding muscle, but distinct from it in the whole length, and is sometimes joined by some fibres of the orbicularis palpebrarum; or its place may be taken by a fleshy slip from this muscle. It may be altogether wanting. *with orbicularis.*

The *zygomaticus major*[9] arises from the malar bone near the zygomatic suture, from which it descends, lying inferior and external to the smaller muscle of the same name, to the angle of the mouth, where it is continued into the orbicularis and depressor anguli oris. *Zygomaticus major,*

The smaller muscle, at its origin, may be concealed a little by the orbicularis palpebrarum; but both are afterwards subcutaneous in the rest of their extent. The larger one crosses, just below its origin, a part of the masseter and buccinator muscles. *connections.*

INFERIOR MAXILLARY REGION.

This space contains three muscles, viz. the depressor of the angle of the mouth, the depressor of the lower lip, and the elevator of the lower lip.

Depressor anguli oris (fig. 101,[10]) (triangularis oris; maxillo-labialis).—This muscle lies at the side and lower part of the face, being extended from the lower jaw to the angle of the mouth. It arises from the oblique line which is marked upon the external surface of the inferior maxillary bone. It is triangular in form; the base of the triangle corresponding with its origin, and the apex with its insertion into the angle of the mouth. Its fibres pass upwards, gradually converging so as to form a narrow bundle, which is inserted into the angle of the mouth, here becoming blended with the orbicular and great zygomatic muscles, and also with the termination of the levator anguli oris. It is covered by the skin, and, at its insertion, by the zygomaticus major, under which its fibres pass; it conceals part of the buccinator, and of the depressor of the lower lip. *Depressor anguli oris; origin, triangular in form, ends at mouth. Parts that cover it.*

Depressor labii inferioris (fig. 101,[11]) (quadratus menti; mento-labialis) is a small square muscle, lying nearer to the symphysis of the chin than the preceding muscle, by which it is partly concealed. It *arises* from the fore part of the inferior maxillary bone near the lower border, and this attachment reaches from the symphysis to a little beyond the labial foramen: thence its fibres ascend to be inserted into the lower lip, blending with those of the orbicularis oris, and having previously united with those of its fellow *Depressor labii inferioris is square. Attached to lower jaw.*

Fat is mixed with the fibres.

of the opposite side. It presents rather a peculiar appearance when dissected, owing to a quantity of yellow adipose matter being deposited in the interstices of its fibres.

Levator menti is inside the lip,

Elevator labii inferioris proprius — Cowper, (levator menti) (fig. 101,[12]) arises from a slight pit a little below the alveolar border of the lower jaw, near the symphysis. This pair of muscles occupies the interval between the two depressors of the lower lip. Each is small, short, and somewhat tapering, being narrow at its point of origin;

and ends in integument of chin.

but it increases in breadth towards its insertion. Both incline downwards and a little forwards to reach the tegument of the chin, into which they are inserted.

They act on the apertures of the eye and nose.

Actions.—The names of most of the muscles included in the three foregoing groups sufficiently indicate their actions upon the lips, the nose, and the mouth. In conducting their dissection, they will be found to be intimately connected with the skin which covers them: and from this circumstance they are enabled to give to the face all those changes of state which are necessary for the expression of passion and feeling.

INTER-MAXILLARY REGION.

At each side of the face in the cheek is a muscle, the buccinator, and round the margin of the mouth, one, the orbicularis oris.

Buccinator

The *buccinator* (fig. 101,[13]) (alveolo-labialis) is a thin wide plane of muscular fibres, quadrilateral in figure, occupying

attached to maxillary bones,

the interval between the jaws. It is attached, by its upper and lower margins, to the outer surface of the alveolar parts of the maxillary bones, from the first molar tooth in each, as far back as the last; and between these bones it is fixed

and pterygoid maxillary ligament.

behind to a narrow band of tendinous fibres, extended from the internal pterygoid plate to the posterior extremity of the mylo-hyoid ridge of the lower jaw, close to the last molar tooth. From these points the fibres are directed forwards, approaching each other, so that the muscle is narrowed and proportionally thickened near the angle of the mouth; here it lies beneath the other muscles, and

Fibres cross at angle of the mouth.

blends with them in this way. The fibres near the middle of the muscle cross each other, those from above entering into the lower lip, and those from below into the upper one; but the higher and lower fibres are directed into the corresponding lip without decussation.

The internal surface of the buccinator is lined throughout by the mucous membrane of the mouth. The external is covered and supported by a thin fascia, which is closely adherent to the muscular fibres; and is overlapped by the triangularis oris, the terminal fibres of the platysma myoides, and by the facial artery and vein; also by the masseter and zygomatici, from which it is separated by a quantity of soft adipose tissue of a peculiar character. Opposite the second dens molaris of the upper jaw, its fibres give passage to the duct of the parotid gland.

Parts in contact.

Covered by fascia and other muscles.

Duct of parotid gland.

The *pterygo-maxillary ligament* (fig. 109,[2]),—The tendinous band connected with the posterior margin of the muscle has, from its attachments, been thus called; one of its surfaces looks towards the mouth, and is lined by the mucous membrane; the other is separated from the ramus of the jaw by a quantity of adipose substance. The anterior border gives attachment, as has been here stated, to the buccinator muscle; and the posterior, to the superior constrictor of the pharynx. It is this connection between the muscles just named which establishes a complete continuity of surface between the cavity of the mouth and that of the pharynx.

Pterygo-maxillary ligament

connected with buccinator and the pharynx.

Risorius (Santorini).—By this name a small bundle of muscular fibres, of varying size and shape is known. Usually broadest at the outer end, it commences in the fascia over the masseter, and extends transversely inwards in the fat of the cheek, to join the depressor anguli oris below the angle of the mouth. It is placed over (superficial to) the platysma where this reaches the face, and crosses the fibres, and for these reasons was described as a separate muscle by Santorini.

Risorius muscle;

position;

distinct from platysma.

Orbicularis oris (fig. 101,[14]; fig. 102,[7]) (labialis). Like other sphincter muscles, it is elliptic in form, and is composed of concentric fibres, so placed as to surround the aperture of the mouth; but unlike most of those muscles, only a few of its fibres form uninterrupted loops around the opening they bound. From a difference in the fibres they may be divided into an inner or labial, and an outer or facial part.

Orbicularis oris muscle,

how resembles, how differs from, sphincters.

The labial or marginal portion reaches outwards from the oral aperture as far as the red part of the lip, and forms a roundish fasciculus of pale, fine fibres closely applied to each other. Its fibres are free from bony attachment, and are traceable from one lip to another around the corner of the mouth.

Its inner part

not fixed to bone.

The outer part

The facial portion, thinner and wider than the other, blends by its outer border with the several muscles that converge to the mouth from the contiguous parts of the face.

has partly borrowed, partly special fibres.

Besides these borrowed fibres it has special fibres that are attached to the subjacent cartilage and bone, viz., in the upper lip two bundles for each half; and in the lower, only one for the corresponding part.

Origin of special in upper

In the upper lip one of the fleshy slips (accessorii orbicularis superioris) * is thin and weak, and is attached opposite the incisor teeth, close to the alveolar edge of the upper jaw-bone; and the other,† thicker and pointed, is fixed to the septum of the nose.

and lower lip.

In the lower lip the reinforcing fasciculus (accessorii orbicularis inferioris ‡) arises from the surface of the lower jaw, near the root of the canine tooth, and external to the lèvator labii inferioris. From these points of attachment the fibres are directed outwards towards the angle of the mouth and blend with the rest.

Connections of the edges

The orbicular muscle is flat and thin, with one edge free at the opening of the mouth, and the other united with the adjacent muscles.

and surfaces.

To the inner part of the muscle the skin is closely connected, whilst fatty tissue is interposed over the outer part. The inner surface is in contact with the mucous membrane and the labial glands, as well as with the coronary arterial arch in each lip.

The size and shape of aperture of mouth,

Actions.—The aperture of the mouth is susceptible of considerable dilatation and contraction: the former being effected by the different muscles which converge to it, and which may be compared to retractors drawing with different degrees of obliquity the lips, or the angles, in the direction of their respective points of attachment; and the latter, by the shortening of the labial fibres, and the special fleshy slips that are directed outwards to the angles. The condition of the lips changes during the action of the two parts of the sphincter. If both parts of the muscle act at the same time the width of the oral aperture is greatly diminished, and the lips are projected; but if the outer part alone acts, the lips can be straightened, and pressed together, their margins being everted; whilst if only the inner fibres are contracted, the red margin of the lips will be inverted.

* Secundus fibrarum ordo (Santorini); sur-demi-orbiculaires (Winslow). † Naso-labialis (Albinus).

‡ Productores labri inferioris (Santorini); accessores buccinatoris (Courcelles); les accessoires du demi-orbiculaire inférieur (Winslow).

The buccinator contracts and compresses the cheeks; this power is brought into play when any substance becomes lodged in the interval between it and the jaws. The fibres of the muscle are first elongated and pressed outwards; but when they begin to act they form a flat surface, and force the substance back into the cavity of the mouth. and the condition of the cheek altered by muscles.

It is obvious that the orbicular muscle must be the direct antagonist of all those that converge to it.

TEMPORO-MAXILLARY REGION.

This space, extending from the side of the head to the angle of the jaw, contains the temporal and masseter muscles.

Dissection.—To see the masseter muscle, and with it the duct and the surface of the parotid gland, it will suffice to reflect back the skin from the lines of incision indicated in the previous dissections. In doing this, a large branch of the facial nerve will be found accompanying the parotid duct. This will serve as a clue to the trunk of that nerve, by following it back through the substance of the parotid gland; and, when the trunk is found, there can be no difficulty in pursuing all its branches, as they diverge from that point in three different directions over the face and side of the head. To see masseter, and facial nerve.

The next thing to be done is to get at the insertion of the temporal muscle, and at the same time bring into view the pterygo-maxillary region. Proceed as follows:—

With a sharp chisel and mallet the zygoma may be divided at both extremities, and the attachment of the temporal fascia to its upper border severed. The bony arch, with the masseter still connected with it, may be drawn down to the angle of the jaw, the fibres of the latter being at the same time detached from the ramus. In the next place, with Hey's saw, the ramus of the jaw may be divided by a perpendicular cut, carried from just before its condyle to a level with the alveolar border, and there met by another line carried forwards to the latter, so as to insulate and detach all that part of it which belongs to the coronoid process. This being done, the piece of bone, with the temporal muscle attached, may be drawn upwards, so as fully to expose the two pterygoid muscles (*pterygo-maxillary region*), the internal maxillary artery, the gustatory and dental nerves, and the pterygo-maxillary ligament which gives attachment to the buccinator and superior constrictor muscles. Pterygo-maxillary region.

The *masseter* (fig. 100,[15]) (zygomato-maxillaris) is extended from the malar bone and the zygomatic process of the temporal to the side of the lower jaw. Its form is that of an oblong square; its direction downwards and a little backwards. It is a thick, compressed mass of fleshy and tendinous fibres, arranged so as to form two portions, differing in size and direction. Masseter. Position and direction.

Two parts; external, its tendon; The *external*, or superficial part of the muscle, arises chiefly by thick tendinous structures (which afford a large surface for the origin of muscular fibres) from the lower border of the zygomatic arch for the anterior two-thirds; from this attachment its fibres proceed downwards, and a little backwards, to be inserted into the lower half of the ramus of the jaw, extending as far as the angle. The *internal*, or deeper part, has its fibres inclined forwards, and therefore across those of the larger portion. Consisting chiefly of fleshy fibres, it arises from the lower border of the posterior third, and from all the posterior surface of the arch, and is inserted into the upper half of the ramus of the jaw, including the coronoid process. This part of the muscle is concealed in the greater part of its extent by the larger portion, with which its fibres become united at their insertion; part, however, projects behind it, and is covered by the parotid gland.

internal crosses former.

Structures in contact with it. The external surface of the masseter muscle is covered for the most part only by the skin and fascia; it is, however, overlapped behind by the parotid gland, whose duct crosses it; the branches of the facial nerve and the transversalis faciei artery also rest upon it. Its inner surface overlays the buccinator, from which it is separated by some soft adipose tissue; it is in intimate contact with the ramus of the jaw, and covers a nerve and vessels which enter it over the sigmoid notch of the bone.

Temporal. The *temporal* muscle (temporalis temporo-maxillaris; crotaphite—Winslow) is placed at the side of the head, occupying the whole extent of the temporal fossa; it is of considerable size, being broad, thin, and expanded above, where it is attached to the side of the skull, but it becomes thick, compressed, and narrowed to a point below, at its insertion. The fibres of the muscle present a radiating appearance, and are concealed from view by the temporal fascia.

Position, size and shape.

Origin It *arises* from the whole of the temporal fossa; its fibres being implanted into all that special surface which extends from the external angular process of the frontal bone backwards to the root of the mastoid process, and fron the curved line upon the parietal and frontal bones dow wards to the ridge on the sphenoid bone which separa the temporal fossa from the zygomatic; it likewise tal origin from the inner surface of the temporal fascia. T fibres from this extensive origin converge as they descen

from temporal fossa and fascia.

some being directed from before backwards, a considerable number obliquely forwards, whilst those in the middle descend almost vertically; and all terminate in a tendon whose fibres, at first radiating like those of the muscle itself, gradually become aggregated, so as to form a thick flat fasciculus, which is implanted into all the inner surface as well as the anterior border of the coronoid process of the lower jaw-bone. The upper part of this tendon is in a great degree concealed by the muscular fibres, as many of these descend to be implanted into its external surface, whilst the deep-seated fibres come forward from the lower part of the fossa to be attached to its inner surface. Insertion. Tendon.

The lower part, or the insertion of the tendon, is altogether concealed by the lower jaw. Between the muscle and the temporal fossa are the deep temporal arteries and the temporal nerves, which penetrate its substance. Connections.

The *temporal fascia*, by which the muscle is covered and bound down, is a remarkably dense and firm membrane. It is attached inferiorly to the upper margin of the zygoma, where it is separated from the muscle by some loose adipose and connective tissue; but higher up the fascia expands, becoming closely connected with the muscular fibres, and is attached along the curved line bounding the temporal fossa. It gives origin to many of the superficial fibres of the underlying muscle. Its external surface is overlaid by the aponeurosis of the occipito-frontalis muscle, and by the orbicularis palpebrarum: moreover, two muscles of the ear—the superior and anterior—rest upon it; and the temporal artery and vein, with the ascending branches of the temporal nerves, cross it as they pass up towards the arch of the skull. Temporal fascia; its connection with bone and the muscle; with other parts.

PTERYGO-MAXILLARY REGION.

The *internal pterygoid* muscle (fig. 103,[2] and 104,[2]) (pterygoideus internus; pterygo-maxillaris major) is directed to the inner surface of the ramus of the jaw, somewhat as the masseter is to the outer; but it differs widely from that muscle in the extent of its connection with the bone. It is flat and elongated, and its form is like that of the masseter. It *arises* from the pterygoid groove, or fossa,—its fibres, tendinous and fleshy, being attached mostly to the inner surface of the external pterygoid plate of the sphenoid bone, and also to the grooved surface in the tuberosity of the Internal pterygoid internal to ramus of maxilla. Origin.

palate bone, which is inserted between the pterygoid plates.

Direction and insertion.

From these points of attachment the muscle inclines down-

Fig. 103.*

wards, with an inclination backwards and outwards, to be inserted into the angle, and the inner surface of the ramus of the jaw, as high as the dental foramen.

Adjoining structures.

The external surface of the muscle above the place of its insertion is separated from the ramus of the maxilla by the internal lateral ligament, and by the internal maxillary vessels, with the dental artery and nerve; and at its upper part is crossed by the external pterygoid muscle. Its inner surface, whilst in the pterygoid groove, is in contact with the tensor palati muscle; and lower down it corresponds with the superior constrictor of the pharynx.

External pterygoid; deep situation; is horizontal, and triangular.

The *external pterygoid* muscle (figs. 103^{1}; 104^{1}) (pterygoideus externus; pterygo-maxillaris minor) is placed deeply in the zygomatic fossa, extending horizontally backwards and outwards from the process of the same name to the condyle of the lower jaw. Its form is somewhat triangular,—its base corresponding with the origin, and its apex with the insertion. The two extremities are tendinous; but the rest of the muscle forms a short, thick, fleshy mass,

* A vertical section having been made through the skull and face, a little to the left of the middle line, the two pterygoid muscles are seen on the inner surface. 1. The posterior extremity of the external pterygoid muscle. 2. Internal pterygoid, which is exposed in nearly its whole length.

whose upper fibres descend a little, and the lower ascend as they pass between their points of attachment, whilst those in the middle are horizontal.

Fig. 104.*

Origin; (two parts.)

At its base the muscle appears to consist of two fasciculi, separated by a slight interval; the upper fasciculus is attached to a part of the external surface of the great wing of the sphenoid bone, which is near the root of the pterygoid process, including the ridge separating the temporal and the zygomatic fossæ; the other (the larger part) is attached to the outer surface of the external pterygoid plate, and to the tuberosities of the palate and upper maxillary bones. It is inserted into the fore part of the neck of the condyle of the lower jaw, and into the inter-articular fibro-cartilage in the articulation of the mandible.

This muscle, from its position in the zygomatic fossa, is concealed by the coronoid process of the jaw, and the insertion of the temporal muscle; but when the masseter is removed, part of it can be seen between that process and the condyle. Its external surface is crossed by the internal maxillary artery, and by the temporal muscle as this passes to the coronoid process. The inner surface rests against the upper part of the internal pterygoid muscle, whose direction it crosses, also the internal lateral ligament of the lower jaw, and the inferior maxillary nerve and the middle meningeal artery. The upper border is in contact with the great wing of the sphenoid bone, and is crossed by the temporal nerve. Between the heads of origin issues the buccal nerve. As the pterygoid muscles diverge to their destinations, they leave between them an angular interval, which transmits the gustatory and dental nerves, and the internal maxillary vessels. Parts which cover the muscle. Those in contact with it.

Actions.—The lower jaw is elevated by the temporal, Elevation

* The outer side of the bones of the face, and a part of the skull, with the two pterygoid muscles. These parts have been brought into view by the removal of the zygoma, and a large portion of the ramus of the lower maxilla, together with the masseter and temporal muscles, and some other structures. 1. External; and 2. Internal pterygoid.

and depression of the jaw. masseter, and internal pterygoid muscles, which conspire to this end. If the two first act together, the elevation is direct; but if the two last act they are enabled by the obliquity of their direction to carry the angle of the jaw a little forwards. After the jaw has been carried forwards, it will be brought back to its usual place by the anterior or depressor muscles of the chin, and by some posterior fibres of the temporal and masseter, which would be stretched.

Triturating movement. The triturating movement is performed almost exclusively by the external pterygoid muscles. If both act together, they, assisted by the elevators, draw the condyles, and therefore the whole jaw, directly forwards, so as to make the lower teeth project beyond the upper: but when only one acts at a given time, it draws the corresponding condyle forwards, the other remaining fixed, and so makes the symphysis of the jaw deviate to the opposite side. A similar movement can be given by the corresponding muscle, and the alternation of these horizontal motions constitutes trituration.

ORBITAL REGION.

In the orbit, in connection with the eye and its appendages, eight muscles are enclosed, viz., the levator palpebræ, and tensor tarsi, together with six muscles of the eye-ball, namely, four straight and two oblique.

Open the orbit, *Dissection.*—It is here taken for granted that the arch of the skull has been previously removed in order to dissect the brain. Now, to gain a clear view of the contents of the orbit, it is necessary to remove the greater part of its roof, and the whole of its outer wall. With this intent the malar bone may be sawed through on a level with the floor of the orbit, and as far back as the spheno-maxillary fissure. The orbital plate of the frontal should in the next place be cut through with a chisel along its inner third, and back to the anterior clinoid process.

and blow up eye ball. Puncture the optic nerve with a coarse needle near the globe of the eye, and push this on into the latter, so as to make a free passage into it, through which you may convey a curved blow-pipe, and with a little air distend the globe; ligature the extremity of the nerve to prevent the air from escaping. The globe can now be drawn gently forward, which will put all the muscles on the stretch; and their dissection merely consists in taking out cautiously the fat which fills the orbit.

Recti; their position. The four straight muscles of the eye surround at their origin the optic nerve, and at their insertion correspond with opposite points of the globe of the eye. Each of them has

a double name, one designation being founded on its situation, the other on its action, as follows; viz., rectus superior vel attollens; rectus inferior v. depressor; rectus internus v. adductor; and rectus externus v. abductor.

Each also named from its action.

The *superior rectus* (fig. 105,[2]) arises close in front of the foramen opticum, and beneath the levator palpebræ[1]; it curves over the globe, and is inserted by tendon into the anterior part of the eye-ball.

Superior rectus.

Fig. 105.*

The *inferior rectus*,[3] *internal rectus*, and *external rectus*,[4] are united in a common tendinous attachment around the circumference of the optic foramen, except above. But the external rectus differs from the others in having two heads of origin; the upper head blends with the superior rectus as above said, the second head arises from a bony point on the lower margin of the sphenoidal fissure close to the dilated inner end; and other fibres are implanted into a fibrous band between the heads of origin.

Three other recti arise together in part.

Two heads of the external;

The four recti thus attached posteriorly, pass forwards diverging, and, after curving over the middle of the globe of the eye (to which they present a flattened surface) in the position implied by their names respectively, are inserted by short tendinous fibres into the fore part of the sclerotic coat, at an average distance of four lines from the margin of the cornea.

Insertion of recti.

In length and breadth there are some differences among these muscles. The external rectus exceeds the internal one in length. On the other hand, the latter (internal rectus) has some advantage in width, being broader than any; and the superior one appears slightly the narrowest of all. Between the heads of the external rectus is a narrow interval, which gives transmission to the third and sixth nerves and the nasal branch of the fifth, with the ophthalmic vein.

Differences in;

parts between heads of external.

The *superior oblique* (obliquus superior v. major; troch-

Superior oblique.

* The superior maxillary bone, with the orbit opened on the outer side to show the eye with its muscles. 1. Levator palpebræ. 2, 3, 4. Superior, inferior, and external recti. 5. Superior oblique represented by a white line. 6. Inferior oblique.

learis—Cowper) is placed at the upper and inner part of the orbit, internally to the levator palpebræ. It arises about a line in front of the inner part of the optic foramen. Thence this long slender muscle proceeds towards the internal angle of the orbit, and terminates in a round tendon, which passes through a fibro-cartilaginous ring or pulley (trochlea), attached to a depression on the frontal bone at the inner margin of the orbit. To facilitate the movement, a delicate synovial sheath lines the contiguous surfaces of the pulley and the tendon; and over both is placed a loose fibrous membrane. At the pulley the tendon is reflected outwards and backwards, passing between the eye and the superior rectus, to be inserted into the sclerotic coat midway between the superior and external recti muscles, and nearly equi-distant from the cornea and the entrance of the optic nerve.—This muscle is covered by the roof of the orbit, the fourth nerve entering its upper surface; and beneath it lie the nasal nerve and the internal rectus muscle.

Origin. The trochlea. Change of direction. Insertion.

Inferior oblique at front of orbit; direction and insertion.

The *inferior oblique* (obliquus inferior) is the only muscle of the eye which does not take origin at the bottom of the orbit. It arises from a minute depression in the orbital plate of the superior maxillary bone, just within the anterior margin of the orbit, and close by the external border of the lachrymal groove. The muscle inclines outwards and backwards between the inferior rectus and the floor of the orbit; and ends in a tendinous expansion, which passes between the external rectus and the eye-ball, to be inserted into the external and posterior aspect of the globe.

Other muscles in orbit.

Besides the six muscles here described as the special motors of the globe of the eye, two others are found within the orbit; these, viz., the levator palpebræ and tensor tarsi, have been already described with the muscles of the eyelids, to which they belong, (page 7).

Action of recti.

Actions.—The four straight muscles are attached in such a way at opposite points of the circumference of the globe of the eye, as, when the parts are viewed together in their natural position, the muscles with the globe represent a pyramid, whose summit is at the optic foramen, and base at the points of insertion. Now, as these points are anterior to the transverse diameter of the globe, and as each muscle, to reach its insertion, curves over the convexity of the eye, it will be obvious that, when in action, its effect must be to turn or rotate the globe, so that the cornea will be directed either upwards or downwards, outwards or inwards, as the

name severally expresses. This will be better seen if a needle be inserted into the middle of the cornea, and each muscle be pulled by holding it with a pair of forceps near its origin. If any two recti act together, the cornea will be turned to a point intermediate between those to which they would direct it if they acted separately. Thus the superior and external recti acting together turn the cornea upwards and outwards, the inferior and internal recti, downwards and inwards. By this succession and combination of action, the recti are enabled to turn the eye with the minutest precision to every point in the field of view. Sir E. Home attributes to them also the power of compressing the globe so as to lengthen its antero-posterior diameter, and thereby becoming the principal means of its adjustment for sight at different distances.

What is the action of the obliqui?

The obliqui are rotators of the eye;

On the whole, it appears most probable that these muscles produce little more than the revolving movements; and that they may with Dr. Jacob be regarded as "rotatory muscles,"—their office being, when acting together, to revolve the eye "round a longitudinal axis, directed from the open [the anterior part] of the orbit to its bottom." * But, supposing them to act singly, the axis would, in all probability, be slightly altered during the rotation. So that under the influence of the superior muscle alone, while the eye-ball was rotated, the pupil would at the same time be directed to the outer and lower side of the orbit; and, during the action of the inferior oblique, the rotatory movement of the eye would be attended with an inclination of the pupil upwards and outwards.

and slightly alter its axis.

MUSCLES OF THE NECK.

The muscles of the neck are numerous, and are rather complex in their distribution. They may be grouped topographically into sets as follows:—

1. Superficial region. — The muscles placed along the side of the neck, which are comparatively superficial, viz. the platysma myoides, and sterno-mastoideus.

* "On Paralytic, Neuralgic, and other Nervous Diseases of the Eye. By Arthur Jacob, M.D." in Dublin Med. Press. 1841.

2. Sub-maxillary region.	Those placed obliquely at the upper part of the neck, viz. digastricus, stylo-hyoideus, stylo-glossus, stylo-pharyngeus.
3. Genio-hyoid region.	Muscles placed towards the fore part of the neck, and above the os hyoides, viz. mylo-hyoideus, genio-hyoideus, hyo-glossus, and genio-hyo-glossus.
4. Sterno-hyoid region.	The muscles placed in front, lying beneath the os hyoides, viz. sterno-hyoideus, sterno-thyroideus, thyro-hyoideus, crico-thyroideus, and omo-hyoideus.
5. Anterior vertebral region.	Those placed deeply at the side and front of the vertebral column, viz. scaleni, rectus lateralis, rectus anticus, major and minor, and longus colli.

All these are in pairs at each side.

Side of neck quadrilateral; its limits.

General view of the Muscles of the Neck.—The head being allowed to hang over a block placed beneath the shoulders, and the side of the neck being turned forward, a quadrilateral space presents itself to our notice, which is bounded below by the clavicle; above by the margin of the jaw, and a line continued back from it to the mastoid process; before, by the median line from the chin to the sternum; and behind by another line from the mastoid process to near the external end of the clavicle. Now, the whole space is divided into two triangles by the sterno-mastoid muscle, which runs diagonally through its area. Each of these requires a particular examination; for in the anterior triangle, whose base corresponds with the jaw, and whose apex lies at the sternum, is lodged the carotid artery; and in the posterior space, the base of which corresponds with the clavicle, that part of the subclavian artery is placed, which may be compressed or tied. A smaller triangle is recognised within the larger anterior space now describe[d] it is circumscribed by the digastric muscle above, the om[o-] hyoid below, and the sterno-mastoid externally.

Two larger triangular spaces, and their boundaries.

Subdivision of anterior.

Posterior divided into two parts by omo-hyoid.

The posterior triangular space, which is commonly sai[d] to be bounded by the sterno-mastoid, the trapezius, a[nd] the clavicle, will be found divided into two parts by [the] omo-hyoideus passing across it. The upper division c[on]tains the cervical nerves, and several muscles. The low[er] and most important (supra-clavicular) part is very sm[all]

and is, in general, distinctly triangular: it is bounded by the sterno-mastoid and omo-hyoid as its sides, and the clavicle as its base, and contains the subclavian artery and the brachial nerves.

Dissection.—When proceeding with the dissection, two incisions may be made through the skin; one directed transversely along the base of the lower maxilla to the mastoid process of the temporal bone; the other in the course of the sterno-mastoid, from the mastoid process to the sternum, so that the angular flap thus marked out may be raised and reflected forwards. By means of an incision made along the clavicle, another flap of skin may be turned backwards, and then the platysma will be exposed in its entire extent; the direction of its fibres should be carefully considered in reference to the operation of opening the jugular vein. If the point of the lancet be directed upwards and forwards in the course of its fibres, it will merely make a fissure between them, and when withdrawn they will contract and close over the wound in the vein so that the operation is rendered ineffectual, and probably an ecchymosis will be produced; but if it be directed upwards and outwards, the fibres will be cut across, and will retract so as to expose the vein and the aperture made in it. The platysma being reflected, the cervical fascia will be fully exposed, particularly if the trapezius be turned back. When the platysma has been dissected off the sterno-mastoid, the os hyoides and larynx, with the muscles connected with them, will be found in the area of the anterior triangular space; together with the sub-maxillary gland and the large blood-vessels (carotid artery and jugular vein) enclosed with the vagus nerve in a sheath. Over the sheath course the nerves to the infra-hyoid muscles.

Dissection for Platysma. Cervical fascia. Cervical nerves. The larger anterior triangle; parts in its area.

SUPERFICIAL CERVICAL REGION.

The two following muscles are extended beneath the skin, along the side of the neck:—

The *platysma myoides* (fig. 101,[19]) (latissimus colli,—Alb.; peaucier) is a thin plane of muscular fibres, superficial to the deep fascia of the neck. Its fibres, which are pale and thin in their entire extent, arise by tendinous bands from the clavicle and acromion, and from the fascia covering the upper part of the deltoid, pectoral, and trapezius muscles; thence they proceed upwards and inwards over the clavicle, and the side of the neck, gradually narrowing and approaching the muscle of the opposite side. At the lower jaw the greater number of the fibres are inserted into the side of that bone from the symphysis to the attachment of the masseter; the inner fibres mingle with those of the opposite platysma in front of the symphysis, and even cross from the one side to the other below the chin, for about an inch, those of the right side overlapping those of the left; and the posterior are prolonged upon the side of the face

Platysma; origin below, insertion above, blends with fellow,

varies in extent on face.

as far as the angle of the mouth, where they become blended with the muscles in that situation, or in some bodies they reach the fascia over the parotid gland, and the cheek-bone.

Parts over and under it

The platysma is covered by the skin, to which it is adherent by subcutaneous tissue that is usually called the superficial fascia of the neck. It covers slightly the pectoralis major, and the upper parts of the deltoid and the trapezius; higher up it lies upon the sterno-mastoid muscle, the external jugular vein, the sheath of the great cervical vessels, the sub-maxillary gland, with the facial artery and the body of the jaw-bone.

Sterno-mastoid. Direction.

The *sterno-cleido-mastoid* muscle (fig. 106,[1]) is extended diagonally across the side of the neck, from the top of the sternum to the mastoid process: it is thick and rounded at

Fig. 106.*

* A front view of the muscles of the neck, from the base of the lower maxilla to the sternum and clavicles.—Together with the integuments, fascia and platysma (which have been removed from both sides), the sterno-mastoid, sterno-hyoid, digastric, and mylo-hyoid have been detached on the left side. 1. Sterno-mastoid. 2. Digastric. 3. Stylo-hyoid. 4. Stylo-glossus. 5. Stylo-pharyngeus. 6. Mylo-hyoid. 7. Genio-hyoid. 8. Hyo-glossus. 9. Lingualis. 10. Sterno-hyoid. 11. Sterno-thyroid. 12. Thyro-hyoid. 13. Omo-hyoid. 14. Scalenus anticus. 15. Scalenus medius. 16. Trapezius. 17. Levator anguli scapulæ.

the middle, so as to be at all times prominent, particularly when in action, but becomes broader and thinner at its extremities. It *arises* by two heads from the anterior surface of the sternum, and the inner third of the clavicle. The attachment to the first piece of the sternum is by means of a thick rounded fasciculus composed of tendinous fibres at its cutaneous aspect, the rest being fleshy. The clavicular portion, separated at first from the preceding by a narrow interval, is flat, and in form somewhat triangular, and is composed of fleshy and aponeurotic fibres. The two heads are directed upwards, the clavicular perpendicularly, and the sternal part obliquely backwards, and both become inseparably blended about the middle of the neck into a thick rounded muscle, which is finally inserted into the anterior border and external surface of the mastoid process, and for some way into the rough ridge behind it, by a thin layer of aponeurotic fibres.

Origin, by two parts;

interval between.

Insertion.

The external surface of the muscle is covered by the platysma for rather more than the middle three-fifths of its extent—the sternal origin and the insertion being in contact with the fascia and skin. In the middle it is crossed by the external jugular vein, and by the ascending superficial branches of the cervical plexus. It rests on part of the sterno-hyoid and sterno-thyroid muscles, and crosses the omo-hyoid muscle; in the middle part of the neck it covers the cervical plexus of nerves and the great cervical vessels, and in the upper part, the digastricus, and stylo-hyoideus muscles: the spinal accessory nerve pierces it. The two sterno-cleido-mastoidei are placed closely together at their sternal attachment, whilst their insertions are separated by the whole breadth of the base of the skull.

Parts adjacent.

Both muscles diverge.

The sterno-cleido-mastoid has been, and occasionally is still described in anatomical works as two muscles, under the names sterno-mastoideus and cleido-mastoideus. The muscle varies much in breadth at the lower end, the variation being due altogether to the clavicular part, which in one case may be as narrow as the sternal tendon, while in another it reaches to the extent of three inches along the clavicle. The same part of the muscle may likewise, when broader than usual, be divided into several slips separated by intervals near the clavicle. A band of muscular fibres has, in a few instances, been found reaching from the trapezius to this muscle over the subclavian artery; and their corresponding margins (which are usually separated by a considerable but varying interval) have been observed in contact.*—A slender

Described as two muscles.

It varies in breadth.

Connection with trapezius.

* "The Anatomy and Operative Surgery of Arteries," by R. Quain, p. 186, and plate 25.

Rectus sternalis. rounded and elongated muscle, about the length of the sternum, has from time to time been seen lying parallel with the outer margin of that bone, and over the inner part of the pectoral muscle. It is fleshy in the middle and tendinous at both ends, and one of these (the superior) is attached to the first bone of the sternum, in connection with the tendon of the sterno-mastoid; the other is usually connected with the aponeurosis covering the rectus abdominis muscle. It is very rarely present on both sides of the same body. The names *rectus sternalis* and sternalis brutorum have been assigned to this "occasional" muscle.

Action of platysma; *Actions.*—The lower part of the *platysma* can exert no action of much importance in the human being. The upper part of the muscle may assist in depressing the jaw and the angle of the mouth; and when its action is general, the skin of the neck becomes slightly creased or wrinkled in a vertical direction. of sterno-mastoid: When the two *sterno-mastoid* muscles act together, they bow the head forwards; but if one acts by itself, it is enabled, by the obliquity of its fibres, to turn the head, and therefore the chin, to the opposite side. alone, It has been said that this muscle can draw the head down to its own side, approximating the ear to the shoulder. and combined. But, to effect this, its action must be combined with that of some other muscle, as the splenius; for then, as the latter arises from the spinous processes, whilst the former comes from the sternum, both converging to the mastoid process, the head will be drawn down by their combined effort to the point intermediate between their attachments, namely, to the shoulder.

SUB-MAXILLARY REGION.

Digastric. The *digastric* muscle (fig. 106,[22]) (digastricus; biventer maxillæ inferioris,—Alb.; mastoido-mentalis) is placed in a curved direction across the upper part of the neck, a little below the margin of the lower maxillary bone. As its Two bellies; name implies, it consists of two fleshy bellies, united by a rounded middle tendon, each of which parts has a separate their origin, insertion, attachment. The posterior belly, which is longer than the anterior, arises from the digastric groove in the temporal bone. The anterior is attached to a rough depression at the inside of the lower border of the jaw-bone, close to the and middle tendon. symphysis. And the tendon is connected with the body and great cornu of the os hyoides by a dense fascia, and by the fleshy fibres of the stylo-hyoideus muscle,[3] through which it (the tendon) passes. The posterior, or submastoid

belly descends inwards and forwards, gradually tapering until it ends in the tendon; the anterior or sub-mental portion passes downwards and backwards, gradually narrowing towards its insertion into the tendon. Now, as the side of the os hyoides is beneath both points of attachment, and nearly in the middle between them, the fleshy bellies, where they end in the tendon, must form an angle with one another.

The anterior belly, lying immediately under the fascia, rests on the mylo-hyoideus muscle, and is connected by dense fascia with its fellow of the opposite side. The posterior is covered by the mastoid process and the muscles arising from it, and crosses both carotid arteries and the jugular vein; its upper margin bounds the sub-maxillary gland; and the lower one forms one of the sides of the smaller anterior triangle of the neck. Parts adjacent.

The *stylo-hyoid* muscle (stylo-hyoideus) (figs. 106,[3]; 107,[1]) lies close to the posterior belly of the preceding muscle, being a little behind and beneath it. It *arises* from the base of the styloid process of the temporal bone at the external surface; from this spot it inclines downwards and forwards, to be inserted into the os hyoides at the union of the great cornu with the body. Its fibres are usually divided into two fasciculi near its insertion, for the transmission of the tendon of the digastricus. Stylo-hyoid, its position. Origin; insertion. Division for digastric.

Its upper part lies deeply, being covered by the sterno-mastoid and digastric muscles, and by part of the parotid gland: the middle crosses the carotid arteries; the insertion is comparatively superficial. Parts in contact.

This muscle is sometimes wanting; occasionally a second is present (stylo-hyoideus alter,—Alb.). The position too may be altered—it has been found beneath the external carotid artery instead of over that vessel.*

The *stylo-glossus* (figs. 106,[4]; 107,[2]) lies higher up, and is also shorter than any of the three muscles which arise from the styloid process. Its direction is forwards and a little downwards, so that it becomes nearly horizontal. It *arises* from the styloid process near the point, and from the stylo-maxillary ligament, to which in some cases the greater number of its fibres are attached by a thin aponeurosis; and it is inserted along the side and under part of Stylo-glossus. Origin. Insertion.

* The work on Arteries, above referred to, plate 12, fig. 5.

the tongue, its fibres expanding and becoming blended with those of the hyo- and palato-glossus muscles.

Parts in contact. This muscle lies very deeply beneath the parotid gland, but before the external and internal carotid arteries. It may be seen to arise occasionally from the inner side of the angle of the lower maxilla; and cases have been observed in which it was altogether absent.

Stylo-pharyngeus. *Stylo-pharyngeus* (figs. 106,[5]; 107,[3]).—This is larger and longer than the other styloid muscles, and also more deeply seated; it extends from the styloid process downwards, along the side of the pharynx. Origin. It *arises* from the inner surface of the styloid process, near the root, and proceeds downwards and inwards to the side of the pharynx, where Passes under constrictor. it passes under cover of the middle constrictor muscle; gradually expanding, it detaches some fibres to the constrictors of the pharynx, and, having joined with the Insertion. palato-pharyngeus, ends in the superior border of the thyroid cartilage.

Parts in contact. The external surface of the muscle is, in the upper part of its extent, in contact with the styloid process and the stylo-hyoideus muscle and external carotid artery; in the lower, with the middle constrictor of the pharynx. Internally it rests on the internal carotid artery and jugular vein; but more inferiorly it is in contact with the mucous membrane of the pharynx. The glosso-pharyngeal nerve is close to the muscle, and crosses over it in turning forward to the tongue.

Action of these muscles on the pharynx. *Actions.*—The *stylo-hyoidei* and *stylo-pharyngei* conspire in elevating the base of the tongue and the bag of the pharynx at the moment when deglutition is taking place, the latter pair of muscles tending at the same time to widen the pharynx. The peculiar mechanism of the *digastric* muscles enables them to contribute also to the elevation of the os hyoides; Hyoid bone, for when the two fleshy parts contract together, they come nearly into a straight line, and thereby draw up the bone just named, by means of the connection of the middle tendon of the muscle with the cornu. As a preparatory measure the mouth must be closed, and the lower jaw or the tongue fixed, as these are the first steps in the process of deglutition. If the os hyoides be kept down by the sterno-hyoideus, the anterior and tongue. belly of the digastricus will serve to depress the lower jaw. The *stylo-glossi* muscles retract the tongue; they act also on its margins, and elevate them; if the genio-glossi (fig. 107 [7]),

come into action at the same time, and draw down its raphé or middle part, its upper surface will be converted into a groove.

GENIO-HYOID REGION.

The *mylo-hyoid* muscle (mylo-hyoideus) (fig. 106,[6]) is a flat triangular muscle, placed immediately beneath the anterior belly of the digastric, and extended from the inside of the inferior maxilla to the os hyoides; its base, or broader part being above, and the apex being below. It *arises* from the mylo-hyoid ridge along the inner surface of the lower jaw, extending from the last molar tooth to the symphysis. The posterior fibres incline obliquely forwards as they descend to be inserted into the body of the os hyoides; the rest proceed with different degrees of obliquity, and join at an angle with those of the corresponding muscle, forming with them a sort of raphé along the middle line, from the symphysis of the jaw to the os hyoides. **Mylo-hyoid, its position. Origin. The two join.**

The external surface of the mylo-hyoid muscle (which in the erect position of the head is inferior) is covered by the digastricus, the sub-maxillary gland, and the sub-mental vessels and nerve. The internal, which looks upwards and inwards to the mouth, conceals the genio-hyoideus and parts of the hyo-glossus and stylo-glossus muscles, the ninth and gustatory nerves, and the sub-lingual gland with the duct of the sub-maxillary. Its posterior border alone is free and unattached, and behind it the duct of the sub-maxillary gland turns in passing to the mouth. **Parts in contact.**

The two muscles of this name, by their junction in front, support the mucous membrane of the mouth, and the tongue, constituting a muscular floor for that cavity. **Both form floor of mouth.**

The *genio-hyoid* muscle (genio-hyoideus) (fig. 106,[7]; fig. 107,[5]) is a narrow muscle, concealed by the preceding, and lying close to the median line. It *arises* from the inside of the symphysis of the chin (its inferior sub-mental tubercle), and thence descends in contact with the corresponding muscle, and increasing a little in breadth, to be *inserted* into the body of the os hyoides. This pair of muscles lies between the mylo-hyoideus and the lower or free border of the genio-glossus. **Genio-hyoid; position; origin.**

The *hyo-glossus* (fig. 102,[5]) is a flat, thin, four-sided band of muscular fibres, extended upwards upon the side of the tongue from the lateral portion of the os hyoides. It *arises* from the whole length of the great cornu of the os **Hyo-glossus. Origin.**

hyoides, and from part of the body of that bone; and a third slip, which is sometimes described, is derived from the small cornu of the same bone. The muscular fibres from the body and great cornu incline upwards and outwards (those from the body of the bone overlapping the others a little), to be *inserted* into the side of the tongue, where they expand, becoming blended with the stylo- and palato-glossus: the direction of this part of the muscle is almost vertically upwards, and that of the stylo-glossus horizontally forwards, so that they decussate upon the side of the tongue.

Insertion.

Parts adjoining.

The hyo-glossus muscle is covered by the digastric and mylo-hyoid, and by other structures just mentioned as lying beneath the latter muscle. It covers the genio-glossus and the origin of the middle constrictor of the pharynx, together with the lingual artery and glosso-pharyngeal nerve.

Was described as three muscles.

Until a comparatively late period, the hyo-glossus was described by anatomists as three muscles; and they were named by Albinus, from the part of the hyoid bone with which they are each connected,—basio-glossus, cerato-glossus, and chondro-glossus.[*] The name by which the whole, considered as one muscle, is now usually known, was suggested by Winslow.

Genio-hyo-glossus,

Fig. 107.[†]

The *genio-hyo-glossus* (fig. 107,[7]) is so called from its triple connection with the chin, os hyoides, and tongue. The muscle forms a thin, triangular plane of fleshy fibres, placed vertically in the median line; the apex of the triangle being represented by its origin from the inside of the symphysis of the lower jaw, the base by its insertion along the

[*] The third part,—chondro-glossus—is distinct from the others, and has a separate ending in the tongue; it may be described most appropriately with the muscular substance of the tongue.

[†] A small part of the skull (including the styloid process of the temporal bone), the left half of the inferior maxilla, the os hyoides, larynx, and a few rings of the trachea, together with the tongue, and several muscles, as follows: viz. 1. Stylo-hyoid. 2. Stylo-glossus. 3. Stylo-pharyngeus. 5. Genio-hyoid. 7. Genio-hyo-glossus. 8. Thyro-hyoid. The hyo-glossus is clearly seen, but it is not numbered.—This sketch is inaccurate, as regards the points at which the muscles are connected with the styloid process.

whole length of the tongue from point to root, for the fibres spread out, radiating like the ribs of a fan. One of the sides (the lower one) corresponds with the border which extends from the symphysis to the os hyoides, the other (upper and anterior) with the frænum linguæ. The inner surface is in contact with the corresponding muscle; and the external is covered by those last described. It *arises*, by a short tendon, from the superior tubercle on the inner side of the symphysis of the chin. To this the fleshy fibres succeed and diverge from one another, the inferior passing down to the os hyoides, above which a few are continued into the side of the pharynx; the anterior fibres are directed upwards to the tip of the tongue; and the rest proceed in different directions to the under surface of the tongue, with which they are blended in its entire length from base to apex. Is fan-shaped. Origin.

The internal surface of the muscle is in contact with that of its fellow, from which it is separated at first towards the posterior part of the tongue by the slight fibrous tissue which runs for some way through the middle of that organ, but both become closely adherent towards their termination. The external surface is in contact with the lingualis, hyo-glossus, and stylo-glossus, the sub-lingual gland, the ranine vessels, and the nerves of the tongue. Connections of parts around.

The proper or "intrinsic" lingual muscles will be described with the other structures of the tongue.

Actions.—The muscles that pass from the jaw-bone to the os hyoides are ordinarily employed in elevating the latter, and with it the base of the tongue, more particularly in deglutition. The genio-hyo-glossi, by means of their posterior and inferior fibres, can draw up the os hyoides, at the same time bringing it and the base of the tongue forwards, so as to make the apex protrude beyond the mouth. The anterior fibres will, subsequently, act in retracting the tongue within the mouth. The mylo-hyoidei may be compared to a moveable floor or bed, which closes the inferior and anterior part of the mouth, at the same time serving to sustain the body of the tongue. Action of the chin, muscles on the hyoid bone and the tongue.

STERNO-HYOID REGION.

The *sterno-hyoid* (sterno-hyoideus) (fig. 106,[10]) lies at the fore part of the neck, near to the middle line, and in part immediately beneath the skin and fascia, extending from the thoracic surface of the sternum or the clavicle to the os Sterno-hyoid.

Origin varies.

hyoides. The *origin* varies between the sternum, the inner end of the clavicle, and the ligament connecting these bones (the posterior surface of each). Thus: it will be found to arise from the sternum and the posterior sterno-clavicular ligaments; from the clavicle and the ligament; or only from the last-named bone. It has likewise occasionally connection to a small extent with the cartilage of the first rib. It forms a flat, narrow band of muscular fibres, and is *inserted* into the lower border of the body of the os hyoides.

Insertion.

Parts in contact.

The muscle is concealed below by the sternum and sterno-mastoideus, higher up only by the skin and fascia; and it lies on the sterno-thyroid and thyro-hyoid muscles, which it partly conceals. The inner border approaches that of the corresponding muscle towards the middle of its extent, but is separated from it by an interval superiorly, and usually by a larger one near the sternum; the outer margin is in contact with the omo-hyoideus near the os hyoides. The muscular fibres are, in many cases, interrupted by a transverse tendinous intersection.

Sterno-thyroid.

Origin.

Insertion.

The *sterno-thyroid*, (sterno-thyroideus; sterno-thyreöideus, —Alb.) (fig 106,[11]) broader and shorter than the preceding, behind which it lies, *arises* lower down than that muscle, from the thoracic surface of the first bone of the sternum. From this spot it ascends, diverging a little from the corresponding muscle, to be *inserted* into the oblique line on the side of the ala of the thyroid cartilage.

Adjoining structures.

The greater part of its anterior surface is concealed by the sternum and the sterno-hyoideus, as well as by the sterno-mastoideus. By the opposite surface it rests on the vena innominata, the lower part of the common carotid artery, the trachea, and the thyroid body. The inner margin is contiguous to the muscle of the other side in the lower part of the neck.

Tendinous intersections.

This muscle is often partly crossed by transverse or oblique tendinous lines. At the upper extremity a few fibres are often found to blend with the other muscles connected with the same part of the thyroid cartilage (the thyro-hyoid and inferior constrictor of the pharynx), and it sometimes happens that a few extend to the os hyoides.

Thyro-hyoid.

Origin and insertion.

Thyro-hyoid muscle (thyro-hyoideus; hyo-thyreöideus,—Alb.) (figs. 106,[12], and 109,[8]).—This appears like a continuation of the preceding muscle, as it *arises* from the oblique line on the side of the thyroid cartilage, and thence passes up to be *inserted* into the lower border of the great cornu, as well as the body of the os hyoides (a portion of

each). Some fibres may be found to be continued from the sterno-thyroid.—It is concealed by the sterno-hyoid and omy-hyoid muscles, and rests on the ala of the thyroid cartilage, and on the thyro-hyoid membrane; between the latter structure and the muscle are placed the superior laryngeal nerve and artery before they enter the larynx. Adjoining parts.

The *crico-thyroid* comes into view with the muscles now under consideration. But as it belongs exclusively to the larynx, the account of it will be more fitly placed among the muscles of that organ, with which it is associated in function.—See the description of the larynx. Crico-thyroid belongs to larynx.

The *omo-hyoid* (omo-hyoideus; coraco-hyoideus,—Alb.; scapulo-hyoideus) (fig. 106,[13]) is in structure a digastric muscle, as it consists of two bellies united by a tendon. One of these (the upper and inner one) lies close to the external border of the sterno-hyoideus muscle, and is covered only by the platysma and fascia; the other is deeply seated, being concealed, in the greater part of its extent, by the clavicle and the sterno-mastoid. It *arises* from the upper border of the scapula, near the supra-scapular notch, and occasionally from the ligament which crosses it. From thence the muscle, forming a narrow flat fasciculus, inclines forwards across the root of the neck, and enters beneath the sterno-mastoideus; here it suddenly changes its direction, and ascends almost vertically, to be *inserted* into the lower border of the body of the os hyoides. The two parts of the muscle here described form an angle, where they lie behind the sterno-mastoid; and are connected to each other by a tendon, which varies much in length and form in different bodies. The tendon is enclosed within the deep cervical fascia, which after forming a sort of sheath for it, is prolonged down and becomes attached to the sternum and the cartilage of the first rib; it is by this mode of connection that the oblique position of the muscle is maintained. Omo-hyoid; is digastric. Origin. Insertion. Middle tendon.

At its origin the muscle is covered by the trapezius, and at its insertion by the platysma; it crosses over the scaleni muscles, the cervical nerves, the sheath of the common carotid artery and jugular vein, and the sterno-thyroid and thyro-hyoid muscles. It subdivides the two large triangles on the side of the neck in the manner stated at page 26. Parts adjoining.

Deviations from the ordinary arrangement and size are not uncommon in the omo-hyoid. One of the most frequent is the decrease in the extent of the tendinous intersection; for this may be found to intercept only a few of the muscular fibres, or it may be altogether wanting. Peculiarities of the muscle.

The muscle occasionally reaches only from the clavicle to the os hyoides, arising from the former bone about its middle, so that the posterior belly is absent.* In one case, on the other hand, the posterior part alone was present, and it was connected to the hyoid bone by a band of fascia.†

Actions of infra-hyoid muscles in deglutition; *Actions.*—All the individuals of this group of muscles take their fixed point below, and therefore act as depressors of the larynx and os hyoides, for they draw down these parts as deglutition is being performed. As a preparatory measure to swallowing, the pharynx is drawn up, so also is the os hyoides; and, moreover, as a means of security, the larynx is made to ascend, at the same moment, so as to be brought under cover of the epiglottis. After the ascent has been effected, the parts do not return to their original position by the mere relaxation of the elevators; they are drawn down by the action of the five muscles just described. The thyro-hyoideus is the only one of the set that can act as an elevator; for when the os hyoides ascends, this muscle can draw upwards the thyroid cartilage with it.

one an elevator.

VERTEBRAL REGION (LATERAL).

Anterior scalenus. The *anterior scalenus* (scalenus anticus; scal. prior,—Alb.) (fig. 106,[14]; fig. 108,[1]) lies deeply at the side of the neck, behind and beneath the sterno-mastoid muscle.

Fig. 108‡.

Origin. It *arises* by a flat narrow tendon, from a rough surface (more or less prominent in different cases) on the inner border and upper surface of the first rib. From this origin the fleshy fibres ascend vertically, to be *inserted* into the tubercles of the transverse processes of the bodies of four cervical vertebræ, from the third to the sixth inclusive.

Insertion.

The muscle is partly covered by the sterno-mastoideus

* See "Anatomy and Oper. Surg. of Arteries," by R. Quain, p. 186, plate xxv.
† Ibid. plate iv. fig. 2.
‡ A small part of the skull: the cervical and a few dorsal vertebræ,

and the clavicle, and is crossed by the omo-hyoideus. The lower part separates the subclavian artery and vein; the latter being in front of the muscle, and the former with the brachial nerves behind it. To its inner side lie the jugular vein and the branches of the subclavian artery. Parts adjacent.

The *middle scalenus* (scalenus medius) (fig. 106,[15]; fig. 108,[7]) is larger and longer than the preceding muscle, from which it is separated below by the subclavian artery, and above by the cervical nerves as these issue from the intervertebral foramina. It *arises* largely from the first rib a little behind the anterior muscle of the same name, being fixed into a groove which extends forwards from the tubercle for an inch and a half. The fleshy fibres ascend along the side of the vertebral column, and are inserted by tendinous processes into the tubercles of the transverse processes of the arches of the last six, or, it may be, of all the cervical vertebræ. Middle scalenus. Origin. Insertion.

The middle scalenus is covered partly by the sterno-mastoid, and is crossed by the clavicle, and the omo-hyoid muscle. To the inner side, and intervening between this muscle on the one hand and the anterior scalenus and rectus major on the other, are the cervical nerves as they issue from the foramina; to the outer side lies the levator anguli scapulæ with the posterior scalenus muscle. Between the attachments of the two scaleni muscles to the upper surface of the first rib, the bone is slightly grooved for the large subclavian artery. Parts jacent

The *posterior scalenus* (scalenus posticus).—This is the smallest of the three scaleni muscles, and is deeply placed behind that last described, in some cases blending with it. It *arises* by a thin tendon from the second rib in front of the attachment of the levator costæ, and, enlarging as it ascends, divides into two or three small tendons, which are fixed into the transverse processes of the arches of as many of the lowest cervical vertebræ. Posterior scalenus. Position. Origin. Insertion.

Two accessory or supernumerary bundles of muscular fibres are occasionally observed in contact or connection with the preceding Occasional muscles.

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and parts of two ribs with the deep-seated muscles, are seen from before. After the separation of the air-tube and gullet, the skull was sawed upwards nearly on a line with the fore part of the spine to expose the structures here represented: further, the scalenus anticus and rectus anticus major were removed from the right side. 1. Scalenus anticus. 2. Scalenus medius. 2*. Scalenus posticus. 3. Rectus capitis antic. major. 4. Rectus antic. minor. 5. Rectus lateralis. 6 and 7. Longus colli. 8. Inter-transversales.

Superior oblique.

direction—two being oblique, the third vertical. *a.* The superior oblique portion (fig. 108,[6]) arises, by a narrow, tendinous process, from the anterior tubercle of the body of the atlas ; from this point its fibres descend obliquely outwards, and are inserted into the fore part of the transverse processes of the bodies of the third, fourth, and fifth cervical vertebræ. *b.* The inferior oblique, the smallest part of the muscle, extends obliquely inwards from the transverse processes of the bodies of the fifth and sixth cervical to the bodies of the first two or three dorsal vertebræ. *c.* The vertical part is placed altogether on the bodies of the vertebræ, and is connected with the two preceding divisions, one being joined to its superior and the other to its inferior extremity. It is fixed above to the bodies of the second, third, and fourth cervical vertebræ ; and the tendinous and fleshy fibres[7] derived from these attachments pass vertically downwards, to be inserted into the bodies of the three lower cervical and two or three upper dorsal vertebræ.

Inferior oblique.

Vertical set.

Connections.

The two muscles of this name are separated by an interval inferiorly, but are near to each other at their upper extremities. They consist of tendinous and fleshy fibres ; the former occupy the anterior surface, particularly at the extremities, some being also deep-seated ; and the fleshy fibres, which are in general short, are placed obliquely between them. These muscles support the pharynx, the œsophagus, the sympathetic nerves, the carotid arteries, and the eighth pair of nerves.

Parts in front of muscles.

Action on the head.

Actions.—The anterior recti muscles are the natural antagonists of those at the back of the neck. They restore the head to its natural position when it has been drawn backwards by the posterior muscles, and, continuing their effort, bow it slightly forwards. Beneath the base of the skull, and at opposite points, we find short and straight muscles, four in front (recti antici), two behind (recti postici minores), one on each side (rectus lateralis), which are the direct agents in the restricted nodding motions that take place between the head and the first vertebra.

PHARYNGEAL REGION.

The muscles of this part form a hollow bag—the pharynx, open in front ; they are the constrictor superior, constrictor medius, constrictor inferior, together with the stylo-pharyngeus and palato-pharyngeus.

Dissection.—After having examined the sides and fore part of the neck let the student when he is about to dissect the pharynx, larynx, and soft palate, proceed as follows:—Cut across the trachea and œsophagus a little above the sternum, and draw both together forwards. There then can be no difficulty in detaching the pharynx from the muscles in front of the vertebral column, as they are merely united by loose connective tissue. When this is done, a piece of cloth should be carried deeply to the base of the skull, and drawn across the pharynx, to serve as a retractor whilst the saw is being used. The edge of the saw should, in the next place, be applied behind the styloid processes, so as to cut through the base of the skull from below upwards, thereby detaching the face, with the pharynx and larynx all pendent from beneath it. The pharynx should be stuffed, to render its muscles tense. When its exterior is sufficiently examined, a longitudinal slit made along the middle line posteriorly will expose its cavity, and that of the mouth and larynx. Preparation of the pharynx.

The pharynx is extended from the centre of the base of the skull to the œsophagus, with which it is continuous; it is placed in front of the vertebral column, between the great vessels of the neck, and immediately behind the nasal fossæ, the mouth, and the larynx, with all which it communicates. Its posterior and lateral parts are loosely adherent to the adjacent structures by connective tissue, and anteriorly it presents the several apertures that lead into the nose, mouth, and larynx. The pharynx is made up, externally, of muscular fibres, arranged in three strata on each side, one partially overlapping another, and the lowest being the most superficial; and internally it is lined by mucous membrane, prolonged from the mouth and nares. These layers of muscle are called the constrictors of the pharynx; they have likewise received other names, taken from their points of attachment, which will be noticed in the detailed description of each muscle. The constrictors form the lateral and posterior boundary of the cavity, and their anterior margins are connected on each side successively with the parts bounding the posterior nares and the mouth; with the lower maxilla, the tongue, the hyoid bone, and the large cartilages of the larynx. The lowest muscle, being the most superficial, will most conveniently be examined first. Pharynx. Position. Arrangement of muscular structure. Connection of constrictors with parts in front.

The *inferior constrictor* of the pharynx (pharyngis constrictor inferior,—Alb.; laryngo-pharyngeus,—Fyfe) (fig. 109,[10]) arises from the external surface of the side of the cricoid cartilage, and from the oblique lateral ridge and the upper and lower borders of the great ala of the thyroid. From these attachments the fibres curve backwards and inwards, converging to those of the corresponding muscle Inferior constrictor. Origin. joins fellow.

Direction of fibres. of the opposite side, with which they unite along the middle line. The direction of the inferior fibres is horizontal, concealing and overlapping the commencement of the œsophagus; the rest ascend with increasing degrees of obliquity, and cover the lower part of the middle constrictor.

Fig. 109.*

Parts in contact. The outer surface of the muscle is in contact at the side of the larynx with the thyroid body, the carotid artery, and the sterno-thyroid muscle; from this last, where both muscles meet on the thyroid cartilage, some fibres are continued into the constrictor. The two laryngeal nerves pass inwards to the larynx, close respectively to the upper and lower margins of this constrictor—one being interposed between it and the middle constrictor, the other between it and the œsophagus.

Was considered two muscles. The inferior constrictor was described by the older anatomists as two muscles which received various names, the most appropriate of these being thyro- or thyreo-pharyngeus and crico-pharyngeus.

Middle constrictor. The *middle constrictor* (constrictor medius,—Alb.; hyo-pharyngeus,) (fig. 109,[11]) smaller than the preceding, is triangular or fan-shaped. Origin. It *arises* from the upper part of the great cornu of the os hyoides, from the smaller cornu, and from the stylo-hyoid ligament. From these points of attachment the fibres proceed backwards, diverging from one another, and are blended with those of the corresponding muscle along the middle line. Blends with fellow. The lower fibres incline downwards, and are concealed by the inferior muscle; the middle run transversely; the rest ascend and overlap the superior constrictor. Direction of fibres.

Parts in contact. This muscle is separated from the superior constrictor by the stylo-pharyngeus muscle and the glosso-pharyngeal

* Intended to show the pharynx supported by a portion of the base of the skull, the inferior maxilla (the ramus being removed), the os hyoides, and the larynx. 1. is above the buccinator muscle. 2. placed on the pterygoid process, points to the pterygo-maxillary ligament. 3. Orbicularis oris. 5. Stylo-pharyngeus, cut short. 6. Mylo-hyoid. 8. Thyro-hyoid. 9. Crico-thyroid. 10. Inferior; 11. middle; and 12. superior constrictor.

nerve, and from the inferior constrictor by the superior laryngeal nerve. Near its origin it is covered by the hyo-glossus muscle, the lingual artery being interposed; and it covers the superior constrictor, the stylo-pharyngeus, the palato-pharyngeus, and the mucous membrane.

The portions of this muscle derived from different places of origin were at one time described as distinct muscles, with names taken from the parts to which they are attached, *e. g.* cerato-pharyngeus, chondro-pharyngeus, &c. Was known as several muscles.

Fibres of the middle constrictor have likewise been observed to arise from one of the following parts, viz. the body of the os hyoides, the thyro-hyoid ligament (syndesmo-pharyngeus of Douglas), and a few are frequently continued into it from the genio-hyo-glossus muscle. The two middle constrictors have been found (Albinus) connected behind to the base of the skull by a fibrous band. Peculiarities.

The *superior constrictor* (constrictor superior, — Alb.; cephalo-pharyngeus, — Fyfe), (fig. 105,[12]) is attached slightly to the side of the tongue and the mucous membrane of the mouth, to the extremity of the mylo-hyoid ridge, also to the pterygoid-maxillary ligament,[2] and the lower third of the internal pterygoid lamella. From these different points the fibres of the muscle curve backwards, becoming blended with those of the corresponding muscle along the middle line, and some end on the aponeurosis that fixes the pharynx to the base of the skull. The upper margin curves over the levator palati mollis and the Eustachian tube; and the space intervening between this concave margin of the constrictor and the base of the skull is closed by fibrous membrane. Superior constrictor. Origin. Joins with opposite. Upper margin.

In contact with the outer surface of this muscle are the internal carotid artery, with large nerves; the middle constrictor that overlaps a considerable portion; and the stylo-pharyngeus, which enters to the pharynx between the two constrictors. It conceals the palato-pharyngeus and the tonsil, and is lined by mucous membrane. Parts in contact;

This, like the other constrictors, has been described as several muscles, each separate attachment being considered a distinct muscle, and named usually by prefixing the name of the place of origin to the word pharyngeus. was described as several muscles.

Salpingo-pharyngeus (Santorini). — Under this name is described a small muscle, which arising from the Eustachian tube, as the name implies (σάλπιγξ, a trumpet), descends in the interior of the pharynx towards the back part, and, after joining with the palato-pharyngeus, is lost in the Salpingo-pharyngeus.

Often wanting.

muscular structure of the cavity. This little muscle is often indistinct, and is frequently absent.

Constrictors form lateral and posterior part of pharynx.

By the peculiar mode of attachment of the constrictor muscles, the bag of the pharynx is completed on the sides and posteriorly, and left open in front; and by the connection of the upper constrictor with the pterygoid processes, as well as with the buccinator through the pterygo-maxillary ligament, a continuous smooth surface is established from the nasal fossæ and the commissure of the lips along the side of the mouth and fauces.—Besides the constrictors two other muscular fasciculi are found at each side in the pharynx. One of these derived from the stylo-pharyngeus,[5] which is insinuated between the adjacent borders of the superior and middle constrictor, has been already described (page 32). The other, the palato-pharyngeus, lies more internally, and will be described with the muscles of the palate (page 49).

Other muscles.

General view of pharynx.

The description of the muscular structure of the pharynx may be given briefly as follows: it may be considered as a single muscle consisting of two symmetrical halves, united by a raphé posteriorly along the middle line, the union extending from near the basilar process to the œsophagus. The superior fibres curve downwards and outwards, to be fixed to the lower third of the internal pterygoid plate, to the pterygo-maxillary ligament, and to the mylo-hyoid ridge and the side of the tongue. The middle set of fibres, broad, and expanded posteriorly at the line of junction, converge as they proceed forwards to be attached to the cornua of the os hyoides and the stylo-hyoid ligament; and are so disposed that part is concealed by the succeeding set, whilst others overlap the preceding series. The lower fibres proceed forwards in the same way, to be attached to the side of the cricoid and thyroid cartilages. The tube is thus complete posteriorly and at the sides, but open in front, where it communicates with the nose, mouth, and larynx.

Parts seen in the cavity.

When the pharynx is slit open, the cavities just mentioned, the apertures which lead into them, and the orifices of the Eustachian tubes (fig. 110) are brought into view.

Actions of preceding in deglutition.

Actions.—The pharynx is drawn up when deglutition is about to be performed, and dilated at the same time in opposite directions. It is widened from side to side by the stylo-pharyngei, which being farther removed from one another at their origin than at their insertion, can thereby

draw outwards the sides of the cavity; and as the os hyoides and larynx are carried forwards in their ascent, the breadth of the pharynx from before backwards is increased, inasmuch as the forepart is drawn in the same direction, by reason of its connection with the larynx. When the morsel of food is propelled into the pharynx, the elevator muscles relax, the bag descends, and then the fibres of its own muscular wall begin to contract and carry the mass down into the œsophagus.

When we contrast the structure of the pharynx with that of the œsophagus, comparing the complex arrangement observable in the one with the simplicity of the other, we see abundant evidence of its being intended for something more than a mere recipient and propellent of such matters as are to be conveyed to the stomach. It exerts an important influence in the modulation of the voice, in the production of the higher tones of which it is brought into action. Other uses of the pharynx.

PALATAL REGION.

The soft or pendulous palate (*velum pendulum palati*) forms a partial and movable curtain between the mouth and the pharynx. Its upper border is straight, and attached to the posterior margin of the palate bones: the lower presents, when viewed from before, a curved or arched border at each side, and in the middle a conical depending process, called the *uvula*. From near the uvula, as from a common point of departure, two curved prominent lines extend, one at each side, and proceed downwards and forwards to the side of the tongue: they correspond with the lower or free border of the palate, and mark the limits of the cavities of the mouth and pharynx, for they represent a narrowed or constricted line between these, which is termed the *isthmus* of the fauces. Farther back two other curved lines project from the same spot, one at each side, and extend downwards and backwards along the sides of the pharynx: they diverge from the preceding curved lines so as to leave between them an angular interval, in which is lodged the *tonsil* or *amygdala*. The curved lines here described are usually called the *arches* of the palate, one pair being anterior to the other, and also more prominent. Soft palate; its position; shape; uvula. Isthmus of fauces. Tonsil. Arches of palate.

The soft palate contains five pairs of muscles, enclosed by mucous membrane.

To see the muscles of palate.

Dissection.—When the pharynx has been dissected and examined, it may be opened by an incision along the middle line or raphé to expose the soft palate. Let the uvula be drawn down so as to render it tense; then the small muscles of the palate are at once exhibited by detaching the mucous membrane. The levatores palati are brought into view by merely removing the mucous membrane from the posterior surface of the soft palate. The circumflexi will be found along the internal pterygoid plates: their aponeuroses, which form the principal support of the soft palate, will be seen in front by dissecting off a thick layer of glandular substance, which is continued downwards upon it beneath the mucous membrane.

Levator palati enters pharynx.

Levator palati mollis (fig. 110,[1]).—This is a long, thin, roundish muscle, which passes to the interior of the pharynx above the concave upper margin of the superior constrictor, and occupies the posterior surface of the soft palate.

Fig. 110.*

Origin.

It *arises* from the extremity of the petrous portion of the temporal bone, before the orifice of the carotid canal, and from the cartilaginous part of the Eustachian tube.

Position in palate.

The two muscles, converging as they descend, become flattened in the velum, and join with each other at the middle of the palate. At their ending they are placed behind the other muscles, with the exception of the azygos uvulæ and some fibres of the palato-pharyngeus.

Other names.

This muscle has been described by anatomists under the names (among others) salpingo-staphylinus and petro-salpingo-staphylin, which express its points of attachment more or less completely.

Tensor palati.

Circumflexus, or *tensor palati*, (pterygo-staphylinus; spheno-salpingo-staphylin) (fig. 110,[2]) presents two portions

* The pharynx having been laid open from behind, the constrictors were turned outwards, and the mucous membrane was removed from them and from the soft palate. The posterior nares, the tongue, and the opening into the larynx are seen, together with the following muscles, viz.—1. Levator palati mollis. 2. Circumflexus palati. 3. Azygos uvulæ. 4. This number rests on the tongue; it points to the palato-glossus. 5. Palato-pharyngeus. 6. Posterior naris of one side.

which differ in their directions and relations. The muscle *arises* broad and thin from the small fossa (navicularis) at the root of the internal pterygoid plate of the sphenoid bone, from the anterior surface of the cartilage of the Eustachian tube, and from the adjacent bone, viz., the spine of the sphenoid, and the tympanic process of the temporal bone. From these points it descends perpendicularly between the internal pterygoid muscle and the osseous lamella of the same name, and ends in a tendon, which winds round the hamular process; thence it inclines inwards, and expands at the same time into a broad aponeurosis, which is inserted into the posterior border of the palate bone. In the soft palate the tendon blends inferiorly with the aponeurosis of that part; and a bursa is interposed between it and the point of the pterygoid process.

Origin.

Changes in direction.

Aponeurosis.

Insertion.

Azygos uvulæ (Morgagni) (fig. 110,[3]) (palato-staphylinus —Douglas), was so called from its having been supposed to be a single muscle; but there are really two thin fasciculi, separated by a slight cellular interval above, which usually unite towards the lower part. Each arises from the tendinous structure of the soft palate, and, it may be, from the pointed process (spine) of the palate bone; and, descending vertically, it blends with the other structures in the uvula. The muscle of the uvula lies behind the preceding muscles of the soft palate.

Azygos uvulæ.

Attachments.

Palato-glossus, or *constrictor isthmi faucium* (fig. 110,[4]).— This small muscle inclines forwards and outwards in front of the tonsil to the side and upper surface of the tongue, where it may be considered as inserted. In the soft palate the fibres of this little muscle are continued into that of the opposite side, so that the two palato-glossi form to a certain extent but one muscle. It is merely covered by the mucous membrane, which it renders prominent, so as to form the anterior arch of the palate: in the velum it is anterior to all the other muscles.

Palato-glossus in front of tonsil.

Continuous with opposite muscle.

The *palato-pharyngeus* (fig. 110,[5]) arches downwards and backwards, so as to leave an angular interval between it and the preceding. It commences in the soft palate, where the fibres, separated into two unequal strata by the levator palati and azygos muscles, are connected with the aponeurotic structure of the palate, and join at the middle line with the like parts of the muscle of the opposite side. Descending behind the tonsil into the pharynx, the palato-pharyngeus distributes some fibres in the pharynx, and is

Palato-pharyngeus

is behind tonsil.

attached to the hinder border of the thyroid cartilage. This muscle forms the posterior and larger arch or pillar of the velum palati. Of its two strata in the velum, the posterior is much the thinnest, and is in contact with the mucous membrane of the fauces.

Posterior arch of palate.

Action in deglutition.

Action of the Muscles in deglutition. — The mass of food having been carried back to the fauces by the pressure of the tongue against the hard palate, the palato-glossi (the constrictors of the fauces) contract behind it. The soft palate is raised to some extent, and made tense; and the palato-pharyngei approaching one another nearly touch (the uvula lying in the small interval between them), and prevent the passage of the food towards the upper part of the pharynx, or the posterior nares; at the same time they form an inclined surface for its guidance into the lower part of the pharynx, which is raised to receive the mass by elevator muscles already described (page 46). The concurrent elevation of the larynx, and placing down of the epiglottis over the entrance to the air-tube, have likewise been previously noticed (page 38).

MUSCLES OF THE BACK.

Muscles of the back;

The muscles at the posterior part of the trunk are arranged in layers, or strata, placed one over another, and differing materially in extent, attachments, and use. The superficial muscles are so broad as to cover all the others; and, as their extent is considerable, their number is proprotionably diminished, being only two, viz., the trapezius and latissimus dorsi. They will be considered here in the order in which they are found in proceeding from the tegument to the spine and ribs. Those in each group or layer diminish in size as they increase in number.

arranged in layers.

Number of these.

In the first layer are the trapezius and latissimus dorsi.

In the second, the rhomboidei and levator scapulæ.

In the third, the splenii and serrati postici.

In the fourth, the erector spinæ, sacro-lumbalis, longissimus dorsi, cervicalis ascendens, transversalis colli, trachelo-mastoideus, and complexus.

In the fifth, the semi-spinales dorsi and colli, recti and obliqui.

In the sixth, the inter-spinales, inter-transversales, multifidus spinæ, levatores costarum.

Dissection.—The body being turned prone, the chest and abdomen

To lay bare the muscles of the back.

should be supported by blocks, and the arms allowed to hang over the sides of the table. An incision may be made through the integument, along the spinal column from the occipital protuberance to the sacrum. This should be bounded at its upper extremity by a transverse incision, carried outwards to the mastoid process, and below by another extended along the spine of the ilium. The intervening space may, in the next place, be intersected by two lines; one drawn from the first dorsal vertebra, over the spine of the scapula, the other commencing at the last dorsal vertebra, and carried horizontally outwards.

As the space here marked out is so very extensive, it may be advisable to make an incision obliquely upwards from the last dorsal vertebra to the spine of the scapula, which will correspond with the lower border of the trapezius muscle; and the dissection may be commenced by raising the angular flap of skin thus included, proceeding in the direction of the fibres of that muscle, that is to say, from below upwards and outwards. The other portions of integument should be successively raised, taking care to expose accurately the tendinous fibres where they arise from the spinous processes, as they afford a guide to the fleshy part of the muscle.

When the latissimus and trapezius have been laid bare and examined in their entire extent, a proceeding that will take some time in consequence of the quantity of surface that is to be gone over, they are to be removed, in order that the muscles that lie beneath them may be brought into view.

FIRST LAYER OF DORSAL MUSCLES.

Trapezius. Position, shape, and name.

The *trapezius* (fig. 111,[1]) (cucullaris ;* occipito-dorsi-acromialis) is a flat thin triangular muscle of considerable extent, which is placed immediately under the skin of the neck, as well as that of the back and shoulder. If the two muscles of this name be taken together, they represent a four-sided figure (hence the name); two angles of which correspond with the points of the shoulders, one with the occipital protuberance, and the fourth with the spinous process of the last dorsal vertebra.

Origin.

The trapezius has an aponeurotic origin, 1, from the occipital protuberance, and from about a third of the curved line extending forwards from it; 2, in the cervical region, from a fibrous band, called ligamentum nuchæ; 3, from the spinous process of the last cervical, and those of all the dorsal vertebræ, as well as from the supra-spinous ligament.

Direction of fibres.

From these different points of origin the fibres proceed towards their insertion into the clavicle, the acromion process, and the spine of the scapula following very different directions: those from the occiput inclining downwards and

* "Cucullaris dicitur, quod cum conjuge suo cucullos monachorum non inepte exprimat." Spigelius, "De Hum. Corp. Fabr." 1. 4, § 13.

outwards; and those from the lower part of the back upwards and outwards, the obliquity of each set diminishing, so that those intermediate between the two extremes become horizontal. The superior fibres turn forwards a little, and *are inserted* into the external third of the clavicle; the middle pass transversely to the upper border of the acromion process and spine of the scapula; whilst the inferior ones ascend to reach the upper border and cutaneous surface of the spine, to which they are attached nearly as far back as the triangular impression at which this commences.

Fig. 111.*

Insertion.

Tendinous structure.

Structure: — the trapezius is fleshy in the greater part of its extent, and tendinous at its attachments. The tendinous fibres by which the muscle arises are rather short along the interval from the last dorsal vertebra as high as the fourth; there they lengthen gradually, but opposite the fourth cervical vertebra they again acquire about the same extent, so that in the interval between these points the tendinous part is extensive, and, if the two muscles are dissected at

* The muscles of the back are here displayed. On the left side the integuments only were removed; from the right the trapezius and latissimus dorsi were taken away. 1. Trapezius. 2. Latissimus dorsi. 3. and 4. Rhomboideus minor and major. 5. Levator anguli scapulæ. 6. Serratus posticus inferior. 7. The sacro-lumbalis covered by the vertebral aponeurosis. 8. Splenius. 9. Complexus. 10. Serratus magnus. 11. Deltoid. 12. Supra-spinatus. 13. Infra-spinatus. 14. Teres minor. 15. Teres major. 16. Long head of triceps. 17. External oblique of abdomen.

the same time, the tendons of both together will be seen to have an oval or elliptic form. Again, the muscle is attached to the occiput by fibrous membrane, which from its close connection with the dense fibrous structure beneath the skin, and from its wanting the lustre of tendon, is often inadvertently removed by the dissector. At the insertion to the spine of the scapula, near the base of that bone, will likewise be found a tendinous piece which receives the lowest muscular fibres, and glides over the smooth triangular surface on that part of the bone.

Parts adjacent.

This large muscle is covered by dense superficial fascia, which alone separates it from the skin, so that in the living body its outline is readily discerned when in action. It conceals in part or altogether the following muscles, viz. the complexus,[9] the splenii,[8] levator anguli scapulæ,[5] the supra-spinatus,[12], infra-spinatus,[13] the rhomboidei,[3],[4], and the latissimus dorsi (a small part)[2]. The anterior border, which may be said to turn forward near the clavicle, forms one of the limits of the posterior triangular space at the side of the neck.

Peculiarities.

The trapezius is not unfrequently shorter than usual, and the number of dorsal vertebræ with which it is connected may be diminished even to six or seven. In a very muscular body Tiedemann * found the trapezius and some other muscles (the pectoralis major and gluteus maximus) to a certain degree doubled—an additional muscular layer of some extent being under the ordinary one.—And here it may be mentioned that, where the muscular development is large, added slips or portions will often be found in connection with several of the muscles.

Ligamentum nuchæ.

Ligamentum nuchæ (ligamentum cervicis).—From the line of union of the two trapezii along the neck, a band of condensed fibrous membrane, mixed with tendinous fibres, projects forwards, so as to reach the spinous processes of the vertebræ, forming a septum between the sets of muscles on each side of the middle line. It is attached by its upper extremity to the occipital protuberance, by the lower to the spinous process of the seventh cervical vertebra; its posterior border is blended with the fibres of the trapezii, whilst the anterior is fixed to the spinous processes of the last six cervical vertebræ. This structure is usually named as above. In the human being it can be considered only as a rudiment of that peculiar elastic band which serves to sustain the weight of the head in the lower animals.

Attachments; not elastic.

* "Deutsches Archiv." 1818.

Latissimus dorsi.

Position and form.

The *latissimus dorsi*, (fig. 111,[2]) (dorsi-lumbo-sacro-humeralis,) as its name implies, is of considerable extent, for it occupies the whole of the posterior part of the lumbar region, and the lower half of the dorsal. It is flat, broad, and thin in the greater part of its extent, but it gradually becomes contracted into a narrow fasciculus towards its insertion into the humerus.

Origin.

It *arises* internally by tendinous fibres, from the spinous processes of five or six lower dorsal vertebræ, from all those of the lumbar region, from those of the first two pieces of the sacrum, and from the supra-spinous ligament : over the sacrum the aponeurosis is blended with the tendon of the multifidus spinæ. The muscle takes origin externally from the outer border of the posterior half of the crista ilii ; and by fleshy digitations from the last three or four ribs, which are there interposed between similar processes of the obliquus externus. The tendinous fibres from the two first lines of origin form by their interweaving or union a broad aponeurosis, from which the fleshy fibres proceed, converging towards the axilla. The fibres at the upper part are the shortest, and pass almost horizontally outwards over the lower angle of the scapula, from which they frequently receive a fasciculus of fleshy fibres ; those lower down become longer and incline from below upwards, gradually increasing in the degree of their obliquity ; finally, those which are attached to the ribs ascend almost vertically. By this convergence, the fibres form a narrow and thick fasciculus, which rests on the teres major.[15] It accompanies the teres towards the axilla ; but gradually folding on itself (the fibres from below passing under or in front of those from above, and eventually above them) it likewise turns on that muscle so as to get to its anterior aspect, and is *inserted* into the bottom of the bicipital groove in the humerus by means of a tendon about two or three inches long. The flat tendon by which the latissimus dorsi is inserted becomes united, particularly by its lower border, with that of the teres major.

Aponeurosis.

Fibres converge and are folded.

Insertion.

Structure.

It is aponeurotic at its origin from the spine and the ilium; tendinous at its insertion; and fleshy between,—where it lies over the ribs, the angle of the scapula, and in the fold of the axilla.

Adjacent parts.

The latissimus dorsi is covered by the trapezius at its dorsal origin, and is subcutaneous in the rest of its extent, except where it ascends to the axilla. The anterior surface

rests on part of the rhomboideus major,[4] infra-spinatus,[13] teres major,[14] the serratus posticus inferior,[8] and the deep lumbar muscles; and between the crest of the hip-bone and the last rib, its tendon is united with the fascia lumborum, and binds down the erector spinæ muscle. The internal border corresponds to its fellow, along the middle line. The superior border is free, and describes a slight curve, whose concavity looks upwards; between it and the margins of the trapezius and the rhomboid may be observed a small angular space in which the intercostals are not covered by other muscles. The anterior one, also free in the greater part of its extent, slightly overlaps the obliquus externus,[17] below, and the serratus magnus higher up.[10] On the humerus the tendon is in contact with the axillary vessels and nerves; and a bursa lies between it and the tendon of the teres major.

The latissimus dorsi, like most other muscles of the back, varies in the extent of connection with the bones: thus; the number of dorsal vertebræ to which it is attached varies from four to seven or eight, and the number of the ribs is not constant, as has been already mentioned. A muscular band is often seen to stretch from this muscle across the axilla to the anterior part, where it terminates variously—in the tendon of the greater pectoral, in the coraco-brachialis muscle, or in the fascia. Peculiarities.

Actions.—The trapezius and latissimus dorsi direct or influence the motion of several parts, as must be evident from the extent of their attachments. If the shoulders be fixed, the *trapezii muscles*, acting together, draw the head directly backwards; but, if only one of them acts, it inclines the head to the corresponding side. If the head be fixed, the superior part of the trapezius elevates the point of the shoulder, and sustains it in that position, as when a burden is supported upon it; but if the effort required be considerable, or if it must be continued for any length of time, the cooperation of the serratus magnus becomes indispensable. It would appear at first sight, from the mere inspection of the fibres of this muscle, that those in the middle part of it could draw the scapula directly backwards, and the lower ones draw it downwards. This, however, is far from being the fact. As the muscle is attached to the spine of the scapula and the acromion, it will rather, in consequence of the obliquity of the direction of these processes, communicate a certain degree of rotatory motion to the whole bone, by means of which, when the acromion ascends, the posterior angle descends, and the inferior one comes forward; and,

Action of trapezius

on head;

on scapula.

The scapula rotated;

should the acromion be made to resume its previous position, the inferior angle will move backwards, the superior one upwards. The scapula, then, by the action of the trapezius alone, cannot be made to ascend or descend, to go backwards or forwards, in such a way that the direction of its different parts may remain exactly parallel, in their new situations, to those which they had previously occupied :—this bone will, on the contrary, be found to rotate, as it were, on a pivot driven through the centre of its dorsum. To draw the scapula directly backwards requires the combined effort of the trapezius and rhomboid muscles: for, as their fibres decussate, the direction of the one being obliquely downwards, that of the other upwards, the bone, by their combined action, is made to move in the direction of the diagonal of their forces, that is to say, towards the spinal column.

moved towards the spine.

Action of latissimus dorsi on humerus;

The *latissimus dorsi*, when acting on the shaft of the humerus, necessarily draws it downwards, and gives it at the same time an internal rotatory motion on its own axis, particularly if it had been previously everted, or turned outwards. When the shoulder and arm are rendered fixed, the muscle acts in various ways on the trunk. Thus it assists in forcible inspiration, by drawing on the lower ribs and elevating them. By combining with the abdominal and great pectoral muscles, it elevates and sustains the body in the effort of climbing; and when a person is constrained to resort to the assistance of crutches, the latissimus and pectoralis major are the chief agents in progression.

on trunk.

Both muscles acting on spine.

The trapezius and latissimus dorsi, more particularly the latter, can act under certain circumstances on the spine, preparatory to which the shoulder and arm must become (at least relatively) the fixed points of their attachment. When a man walks close to the margin of a raised foot-path, or of a kerb-stone, and happens to incline a little beyond it, the body becomes curved to that side, and by its weight would carry him over the edge, if a particular effort were not made to prevent such an occurrence. For this purpose the arm of the opposite side is thrown out somewhat from the body, as it were instinctively, so as to render the insertion of the latissimus dorsi into that bone the fixed point of attachment. Thus sustained, the fibres of the muscle are enabled to act on the spine, and, by pulling on those parts of it which are curved, they draw them into a right line with the rest, and so restore the equilibrium of the body.

SECOND LAYER.

Dissection.—To see the rhomboid muscles and the levator scapulæ, the trapezius must be removed. For this purpose, the fibres of the trapezius may be detached from their connection with the clavicle and spine of the scapula, and reflected back to the spine. This will be found easier than the usual plan of detaching it from the latter, both because it is there very thin, and because its fibres are connected with those of the rhomboid muscle. Its dorsal portion conceals the rhomboidei, and part of the latissimus dorsi; and the cervical, the levator scapulæ, the splenius, and complexus. These may be dissected in the course of their fibres, whilst the trapezius is being reflected back towards the middle line; here it may be separated from its fellow of the opposite side along the cervical region, so as to expose the ligamentum nuchæ. In doing this, insert the edge of the knife under the muscle at the occiput, and draw it from above downwards in the line of the spinous processes. Dissection of second layer.

The *rhomboidei muscles* (rhomboides; dorso-scapularis) lie on the same plane, are similar in structure and use, and are separated only by a slight intermuscular interval. They are extended obliquely from the spinous processes of the lower cervical and upper dorsal vertebræ to the base of the scapula. Rhomboid, divided into two.

The *rhomboideus minor* (fig. 111,[3]) *arises* from the spinous processes of the seventh cervical and first dorsal vertebræ and from the ligamentum nuchæ, its fibres being also closely united with those of the trapezius. It inclines downwards and outwards, to be *inserted* into the part of the base of the scapula which is opposite the triangular surface at the commencement of the spine. Minor. Origin. Insertion.

Rhomboideus major[4].—This is three or four times broader than the other, with which it is in close contact, and is immediately below. It *arises* from the spinous processes of the four or five upper dorsal vertebræ, and their interspinous ligaments, and is *inserted* into that part of the base of the scapula included between the spine and inferior angle. Some of the fibres, instead of being fixed to the bone, end on a tendon which is connected to the scapula above the lower angle; and, in consequence of this arrangement, the muscle may, in part, be separated from the bone without division of its muscular or tendinous fibres. Major. Origin. Insertion into bone and a tendon.

The rhomboideus major is covered by the trapezius in the greater part of its extent, and towards the lower part by the latissimus dorsi; but, when the arm is drawn away from the side, a small portion is left uncovered by these muscles, where they diverge at the base of the scapula. Parts over and under muscles.

The rhomboidei rest against the serratus posticus superior, and the posterior scapular artery, with the ribs and deep muscles.

Levator anguli scapulæ. The *levator anguli scapulæ*[5] (trachelo-scapularis)* is placed along the side and posterior part of the neck, forming a long and rather thick fasciculus of fleshy fibres. Origin. It *arises* from the tubercles, of the neural transverse processes of the first three or four cervical vertebræ, by so many tendinous points. From these the fleshy fibres proceed, being at first slightly separated, but soon united to form a flat muscle, which is directed along the side of the neck downwards and a little backwards, and is *inserted* into the portion of the base of the scapula included between the spine and superior angle. (Insertion.)

Parts adjacent. The muscle is covered by the sterno-mastoid muscle above, and by the trapezius below; it rests on the splenius colli, and the transverse cervical and posterior scapular arteries.

Peculiarities. The levator anguli scapulæ may be found connected with but two vertebræ, or the number may be increased to five. A slip has been observed to extend to it from the mastoid process of the temporal bone (Theile), and from the second rib (Meckel). It often appears as several muscles, the parts connected with the vertebræ remaining separate, even to the place of insertion.

THIRD LAYER.

Dissection of third layer. *Dissection.*—After having examined the muscles of the second layer, they must be removed in order to gain a view of those underneath them. For this purpose, the rhomboidei may be detached from the base of the scapula, and reflected backwards, which is the easier mode of attaining the end desired, and avoids any risk of raising with them the serratus superior, which is intimately connected with their origin. The aponeurosis of the latissimus dorsi may be divided by an incision carried from above downwards, along its middle; and, as the external half is reflected outwards, its intimate connection may be observed with the obliquus abdominis, along the border of the deep lumbar muscles. The other portion of the aponeurosis may be drawn back towards the spine, by which means the serratus posticus is left untouched. The serrati and their connecting membrane may then be inspected.

Serratus posticus superior (cervici-dorso-costalis) is placed

* This muscle was known as the "musculus patientiæ," having been so named by Spigelius for the reason which he thus expresses:—"Secundus, scapulam attollens et leuator dictus, à me vero per jocum *patientiæ musculus*, quod ægrè ferentes, quæ nobis aduersa accidere, scapulam huius ope, cum humero, patientiæ amarum ingeminantes nomen, eleuemus."—Spigelius, "De h. corp. fabr." l. 4, § 13.

ver of the rhomboideus; it is flat, and very thin. from the ligamentum nuchæ, and the spines of the ical, and two or three upper dorsal vertebræ, by a ieurosis, which inclines downwards and outwards; ming muscular, is *inserted* by four fleshy digitations second, third, fourth, and sometimes fifth ribs, a ond their angles. It is directed obliquely down- d outwards, resting on the deep muscles and the the ribs. The aponeurosis forms a large part of muscle.—It is covered by the rhomboid and nguli scapulæ, and lies against the deeper muscles ck.

Serratus posticus superior. Origin. Insertion. Parts over and under.

us posticus inferior (fig. 111,[6]) (dorsi-lumbo-costalis). broader than the preceding muscle, from which it ted by a considerable interval, as one of them ds with the upper, the other with the lower ribs. from the spinous processes and inter-spinous liga- the last two dorsal and two or three upper lumbar , by a thin aponeurosis which forms the greater the muscle. It ends in a fleshy lamella, which is by four broad digitations into the lower border of four ribs. Its direction is oblique upwards and .—The posterior surface is covered by the latissimus ith whose tendon the aponeurotic part is firmly or some extent; the anterior rests on the deep uscles. The upper margin is connected with the aponeurosis.

Serratus posticus inferior. Greater part aponeurotic; is connected with latiss. dorsi and vertebral aponeurosis.

ral aponeurosis.—On the same plane as the last is a thin, semi-transparent lamella thus named, rms a septum between the third and fourth layer of separating those which belong to the shoulder and from those which support the spine and head. Its for the most part transverse; some, however, take ry direction. It is connected below with the tendons latissimus and inferior serratus, and passes above the superior serratus; and as the aponeurosis is from the spinous processes internally, to the hip cia lumborum, and the angles of the ribs externally, with the vertebral groove a sort of angular canal, in e lodged the long extensor muscles.

Vertebral aponeurosis with serrati is a septum between muscles. Covers extensor muscles.

plenius muscle (fig. 111,[8]) is placed obliquely along rior part of the neck, diverging from the muscle of osite side near the occiput, so that the two leave them an interspace, in which the muscles beneath

Splenius diverges from opposite muscle near occiput.

(complexi) come into view. The splenius is extended from the spinous processes of the upper dorsal and lower cervical vertebræ, to the side of the base of the skull, and to the neural transverse processes of some cervical vertebræ. This separation at the superior attachment has given occasion for the division of this muscle into two parts; the lower being named splenius colli, the upper splenius capitis.

Division into two parts.

Splenius colli.

The *splenius colli* (dorso-trachelius) *arises* from the spinous processes of four dorsal vertebræ, from the third to the sixth inclusive; the fibres ascend, forming a thin muscular plane, which is *inserted* by separate points into the transverse processes (diapophyses) of the first three cervical vertebræ, with the origin of the levator anguli scapulæ.

Splenius capitis.

The *splenius capitis* (cervico-mastoideus) is placed above the preceding, and is also broader and thicker than it. It *arises* from the spinous processes of the seventh cervical and first two dorsal vertebræ, also from the ligamentum nuchæ opposite the sixth, fifth, and fourth. From these points its fibres proceed upwards and outwards, to be *inserted* into the lower end and hinder part of the mastoid process, and into the line curving upwards and backwards from it. Structure: —tendinous at its attachments, fleshy in the rest of its extent.

Insertion.

Parts over and under splenii.

The splenius (the cranial and cervical parts being taken together) is covered by the trapezius, the rhomboid, and the serratus posticus superior; by the sterno-mastoid on the cranium. It conceals, in part, the complexus and trachelo-mastoideus.

Peculiarities.

The splenius differs, in different cases, as to the number of the vertebræ with which it is connected; and the two parts into which it is considered divisible vary in the extent to which they are really distinct from each other.

Action of levator anguli scapulæ and rhomboid.

Actions.—The *levator anguli scapulæ* combines with the *rhomboideus* in one of its more obvious actions. When the acromion process is elevated, the posterior angle of the scapula is depressed, and the inferior one carried forwards; but, as soon as the more powerful muscles cease to act, the levator draws upwards the posterior angle of the bone, whilst the rhomboid carries backwards and upwards the inferior angle, thus giving a slight rotatory motion to the whole bone, and at the same time depressing the acromion and point of the shoulder.—If the shoulder be fixed, the levator may incline the neck down to the same side, just as the trapezius draws the head under the like circumstances.

ıferior, in consequence of its connection with the ıponeurosis, probably exerts some influence on the ıscles, by making that membrane tense.

plenii muscles of both sides act together, they draw lirectly backwards, in which they conspire with the and trapezius. When that of one side acts , it inclines the head laterally, giving it at the a slight rotatory motion. The *complexus*, too, by the oblique direction of its fibres, can give a certain horizontal motion to the head, but in a direction o that of the splenius, as must be evident from the the fibres of the one incline outwards as they ıd those of the other inwards.

Action of splenius

and complexus.

FOURTH LAYER.

ı.—When the muscles of the third layer have been suf- mined, the serrati and the aponeurosis are to be divided in and reflected the one piece inwards, the other outwards. is done, the sacro-lumbalis and longissimus dorsi may be ı below upwards, by merely passing the handle of the g the slight interval which separates them. The next tach the splenii at their origin, by an incision carried from ıwards, close to the spinous processes. These muscles their upper part, and leave between them an interval, in omplexi are seen. When the splenius has been detached ertebræ and reflected outwards, the transversalis cervicis o-mastoideus can be followed along the neck, taking them as ıs of the long dorsal muscles.

Dissection of fourth layer of muscles.

spinæ (extensor dorsi communis; sacro-spinalis; talis) (fig. 112).—Beneath the vertebral aponeu- the serrati postici lie the large muscles which ıe trunk and the head in the erect position of the

General view of muscles of spine. Their

Reason of this.

each is indistinct, and as many associate for every change in the attitude or movement of the trunk, the points of attachment for the muscles are very numerous, and their fibres are short and incompletely separated; in so much that they are more or less conjoined one with another from end to end of the vertebral column.

Fig. 112.*

Size in different situations.

The erector spinæ is small and pointed below, where little more exists than the tendon of origin, and becomes suddenly enlarged in the lumbar region; — and this part may be considered the source from which fibres spread upwards to the bones. In the dorsal region it gradually lessens, being expended on the vertebræ and the ribs, till, in the neck, no more than a vestige of the lumbar mass remains. Finally, in this last situation there are added, as it were to support the neck and the head in the erect position, special muscles of considerable size (splenius and complexus) between which the slender prolongations of the erector spinæ will be found.

Origin;

Origin of the erector spinæ.—At the lower end, where it is not divided on the surface, and where, the connections

* The deep muscles of the back, seen by removal of those displayed in fig. 111, are here represented. 1. Sacro-lumbalis. 2. Cervicalis ascendens. 3. Longissimus dorsi. 4. Transversalis cervicis. 5. Trachelo-mastoid. 6. Spinalis dorsi. 7. Complexus. 8. Semi-spinalis colli. 9. Semi-spinalis dorsi. 10. Rectus posticus major. 11. Rectus minor. 12. Obliquus inferior. 13. Obliquus superior. 14. Inter-spinales. 15. Multifidus spinæ is indicated by this number. 16. Quadratus lumborum. 17. Levatores costarum.

being more fixed, it must be said to take origin, the mass is covered by a broad thick tendon, which is common to it and the multifidus spinæ. The muscular fibres, taking origin from the tendon, and from about the posterior fifth of the iliac crest of the hip bone on the inner aspect (directly and through the medium of fibrous structure in their substance), form a single mass, to which the name erector spinæ might be confined. The muscle is limited in front (towards the abdomen) by the transverse processes of the lumbar vertebræ and the layer of the lumbar fascia connected with these processes; and divides, near the last rib, into two parts of unequal size—one external, the other internal and larger—which will now be separately considered.

From large tendon, and from bones.

Division into two parts.

Ilio-costalis or *Sacro-lumbalis* (extensor dorsi externus) (fig. 112,[1]).—The external and smaller portion of the erector spinæ separates from the outer side of the general mass near the last rib, and ends in a series of tendons, which lie on its posterior surface, and are fixed to the lower ribs at their angles. The tendons derived from the lumbar mass may be said to be exhausted at the middle of the dorsal region (at the sixth or seventh rib), but the muscle is reinforced by bundles of muscular fibres, which take origin from the upper margins of all the ribs by thin flat tendons; and, by means of these additions, the sacro-lumbalis is continued to the higher ribs, as well as to the transverse processes of some of the cervical vertebræ. There is no separation between these accessory bundles, but they are usually considered to form two muscles, which are named "accessorius" and "cervicalis ascendens."

Ilio-costalis.

Insertion into six ribs.

Continued by accessory fibres.

Accessorius ad sacro-lumbalem.—The bundles of muscular fibres, derived from the lower six or eight ribs, are known under this name. They commence by flat tendons connected with the upper margins of the ribs, and, again ending in tendons, constitute that part of the sacro-lumbalis which is inserted into the higher ribs. To expose the accessorius, the lower part of the sacro-lumbalis (beneath which it lies) must be separated from the longissimus dorsi and turned outwards.

Accessorius arises from lower ribs and inserted into upper.

Cervicalis ascendens v. *descendens.*[2]—Thus are named the accessory slips, taking origin from four or five of the higher ribs, and continued upwards to terminate on the transverse processes (diapophyses) of three cervical vertebræ (usually sixth, fifth, fourth). This part of the muscle lies to the inner side of the tendons of the sacro-lumbalis which terminate on the

Cervicalis ascendens, superior part of accessory fibres.

highest ribs, and is recognised by this position and its muscular appearance. In the neck it is overlapped by the levator anguli scapulæ, lying between this and the complexus. It blends with the transversalis cervicis—an elongation from the muscle to be next described, and, if long enough, with the cervical insertion of the splenius.

Other names of muscles.

Some anatomists, considering the name sacro-lumbalis not an appropriate one for the muscle, inasmuch as it is not attached to either the sacrum or the lumbar vertebræ, have suggested substitutes, *e. g.* sacro-costalis : ilio-costalis (Theile). But neither of these is quite unobjectionable as indicating all the points of attachment of the muscle, for these are so numerous that any name derived from them must either be imperfect or very long.

Under the name "Cervicalis descendens," Diemerbroeck * described the fibres connected with the cervical vertebræ and with all the ribs; but he regarded them as descending from the vertebræ to the ribs, and having the opposite direction to the sacro-lumbalis. The contrary direction of its two sets of fibres this anatomist held to account for the opposite effects ascribed to the ilio-costalis muscle, namely, the alternately raising and depressing the ribs in inspiration and expiration. Stenonis, † it should be observed, had previously given an account of the fibres on the ribs, which are now known as the accessorius. The name thus applied to all the accessory part of the ilio-costalis or sacro-lumbalis was subsequently appropriated to the upper portion of it, which is commonly described as extending from below upwards, and on this account it was that Meckel suggested the alteration to cervicalis "ascendens."

Longissimus dorsi.

Longissimus dorsi.[3]—The internal larger and longer portion of the erector spinæ is attached to parts situate internally to those which receive the sacro-lumbalis, viz. to the lumbar vertebræ, the dorsal vertebræ, and the ribs within their angles. While the muscular mass of the lumbar region is yet undivided, its inner part (which may be assigned to the longissimus dorsi) is inserted into the whole length of the transverse processes (parapophyses) of the lumbar vertebræ on their posterior aspect, including the tubercles (processus accessorii) projecting from the processes near their bases, and into the small depressions internal to them. Fibres will likewise be found inserted beyond the transverse processes into the layer of the lumbar fascia connected with their points; and this part, with the preceding, forms one broad insertion.

Insertion into lumbar vertebræ;

dorsal vertebræ and ribs.

In the dorsal region, the longissimus dorsi is attached to the extremities of the transverse processes of all the dorsal

* "Anat. corp. hum." l. 5, c. 6.

† "De musculis observationum specimen" in Mangetus, "Bibliotheca Anatom." t. 2, p. 528.

vertebræ by rounded bundles, and to a less number (varying from seven to eleven) of the ribs within their angles by flat and thin fleshy processes. This muscle is continued upwards to the neck and to the cranium by a slender accessory portion, which is described as two muscles—transversalis cervicis, and trachelo-mastoid.

Is continued to neck and cranium.

Transversalis cervicis.[4]—This slender part is placed at the inner side of the longissimus dorsi, and arises from the ends of the transverse processes of the highest dorsal vertebræ, and occasionally the last cervical (about five altogether, but the number and their position are very variable), and is inserted into the transverse processes (diapophyses) of five cervical vertebræ above the last. It blends with the cervicalis ascendens and the trachelo-mastoid; with the latter the fibres are in great part continuous.

Transversalis cervicis is conjoined with trachelo-mastoid.

The *trachelo-mastoid* muscle[5] (part of the complexus; complexus minor), the continuation of the longissimus dorsi to the head, extends, as the name implies, from the neck to the mastoid process of the temporal bone. Placed to the inner side of the transversalis cervicis, and inseparable from it except with the aid of a knife, it arises from the transverse processes of the dorsal vertebræ in common with the preceding muscle, and from the articular processes of the last three or four cervical vertebræ. The narrow flat muscle, constructed from the several small points of origin, and frequently crossed by a tendinous intersection, is inserted into the posterior margin of the mastoid process under the splenius and sterno-mastoid muscles. It conceals partly the complexus and the obliqui capitis; and, on the cranium, the occipital artery crosses immediately beneath it, or, as not unfrequently happens, over it.

Trachelo-mastoid continues longissimus dorsi.

Origin.

Insertion.

Is crossed by occipital artery.

The spinous processes of the superior lumbar and the dorsal vertebræ, which do not give attachment to the large muscles of the erector spinæ and its divisions, have connected with them a series of fleshy and tendinous loops which are described as a distinct muscle as follows:—

Spinalis dorsi.[6]—Placed at the inner side of the longissimus dorsi, and connected exclusively with the spinous processes, (whence the name,) this little muscle arises by tendons (three or four in number) from the first two lumbar and the lowest dorsal vertebræ. And the slender bundle of muscular fibres, which springs from the tendons, ends by being connected with the higher dorsal vertebræ; the number of attachments varying from four to eight. The spinalis

Spinalis dorsi attached only to spines of vertebræ

joined to longissmus dorsi.

is separable from the longissimus dorsi only by artificial means ; and it is connected with the muscle beneath it—the semi-spinalis.

Spinalis cervicis very inconstant in form;

Spinalis cervicis (inter-spinales super-numerarii,—Albinus). —In this place must be mentioned, because of the similitude to the spinalis dorsi, a small muscle, exclusively connected like it with the spines of the vertebræ. The fibres have seldom the same arrangement in two bodies, and they often differ on both sides of the same body. But it may be said that the muscle arises by tendinous or fleshy fibres, forming from two to four heads, from the spinous processes of the fifth and sixth cervical vertebræ, or likewise from others in the immediate neighbourhood of these, including one or two dorsal ; and is again fixed by tendons into the spine of the axis, and, in some instances, to the two vertebræ next below it. The spinalis cervicis is connected with the semi-spinalis and the ligamentum nuchæ.

sometimes absent.

This muscle is sometimes placed over the spinous processes, and hence has been named super-spinalis (Cowper). It may be reduced to a single slip ; and not unfrequently is altogether wanting. Its absence was found to occur in five cases out of twenty-four.*

Complexus.

Complexus[7] (trachelo-occipitalis) is a thick and rather broad muscle, and is situate at the posterior part of the cervical region. It is directed obliquely inwards from the transverse processes towards the spines and the middle line, so that the two muscles of this name approach one another, whereas the fibres of the splenius, which covers it, have the opposite direction ; and the complexi, therefore, are partly seen in the interval left between the splenii of both sides as they diverge to their attachments to the sides of the cranium. The complexus *arises* by about seven tendinous points from the posterior and upper part of the transverse processes of the first three dorsal and seventh cervical vertebræ, and from the articular processes of three more cervical (covering the joints and adhering to the ligamentous fibres which support them). The muscular fibres are soon aggregated into a mass, which is directed upwards and inwards to be *inserted* into the large internal impression between the two curved lines of the occipital bone. Above its middle the muscle is partly crossed by a transverse tendinous intersection.

Approaches opposite muscle.

Origin.

Insertion.

Inter-section.

* A detailed account of a series of observations made with respect to this muscle, by MM. Henlé and Heilenbeck, will be found in Müller's "Archiv. f. Anat. Physiol." &c., 1837.

The muscle is covered by the trapezius, splenius, and the slender muscles attached to the transverse processes of the cervical vertebræ; and is crossed by the occipital artery. It conceals the semi-spinalis colli, the posterior recti and obliqui capitis, together with the deep artery of the neck and several nerves, some of which (last) perforate it. Parts over and under.

Biventer cervicis.—Close by the inner border of the complexus, and in most cases forming a part of it, is a long fasciculus, consisting of two fleshy bellies united by a tendon, and hence named as above. The lower end presents from two to four tendinous and fleshy points attached to as many transverse processes of the dorsal vertebræ from the fourth to the sixth or seventh; and the upper one is inserted on the inner side of the complexus into the upper curved line of the occipital bone. The tendon which divides this muscle is of considerable length, and is usually placed opposite the last cervical or the first dorsal vertebra. And from the spines of one of the vertebræ now named, an accessory slip is often furnished to the biventer at its inner side. Biventer cervicis is joined with complexus. Origin and insertion. Accessory fibres.

The name complexus being so little applicable to the muscle that now receives it, it should be mentioned that the term originally included three muscles, viz. the complexus (of modern writers), the biventer cervicis, and the trachelo-mastoid. Complexus included three muscles.

The complexus and the biventer together constitute the second of the two principal muscles destined to maintain the head poised on the vertebral column in the erect position of the trunk; the splenius, which in a great measure covers it, being the first. Both these muscles may be considered as succeeding to the sacro-lumbalis and longissimus dorsi, and performing at the upper extremity of the spine the functions which the muscles just named discharge at the lower part. It will be observed, too, that the slender elongations of the divisions of the erector spinæ are placed between these two large cervical muscles. Position and office of complexus.

FIFTH LAYER.

Dissection.—To continue the examination of the muscles of the back, those which have been under observation are to be removed:—the complexus must be divided and turned aside (in doing this, the artery and nerves beneath it should be noticed); the spinalis and the longissimus dorsi are to be separated in the dorsal region; and the large tendon of the erector spinæ being divided longitudinally near the spinous processes of the lumbar vertebræ and the sacrum, the erector is to be raised from the inner side and thrown outwards. Then there To expose muscles in vertebral groove.

will lie exposed the muscles which fill the groove of the spine from the middle of the sacrum upwards (excepting from the axis to the occiput, where a different arrangement prevails, to be afterwards noticed), whose fibres will be found stretching obliquely from the transverse or the articular processes to the spines of the vertebræ. In the dorsal and cervical regions a layer of muscular and tendinous structure (semi-spinalis) is distinguished from the more general one (multifidus spinæ), which lies beneath it, and extends from the sacrum to the axis.

The *semi-spinalis* reaches from the lower part of the dorsal to the second cervical vertebra; and though there is no separation in the fibres, the part in the neck is described as a muscle distinct from that in the dorsal region.

Semi-spinalis dorsi.

Semi-spinalis dorsi[9] (transversaire épineux du dos,—Winslow). — This thin and narrow stratum consists of small bundles of muscular structure, interposed between tendons of considerable length. The lower tendons are connected to the transverse processes of the inferior dorsal vertebræ, from the tenth to the fifth inclusive; and the upper tendons to the spines of the higher dorsal and the neighbouring cervical vertebræ, viz. four of the former, and two of the latter. It is covered by the spinalis and the longissimus dorsi, and in some degree by the semi-spinalis colli, and lies on the multifidus spinæ.

Connections.

Semi-spinalis colli thicker than former.

Semi-spinalis colli[8] (transversaire épineux du col).—Considerably thicker than the preceding, this part of the semi-spinalis takes origin from the transverse processes of usually the first five or six dorsal vertebræ, by as many tendinous and fleshy points; and it terminates in about four parts on the spines of the cervical vertebræ, from the second to the fifth inclusive. The part connected with the axis is the largest, and is chiefly muscular. This portion of the semi-spinalis is covered by the complexus and biventer cervicis; it rests against the multifidus spinæ, and is firmly united with this muscle towards the upper end.

Connections.

Both the parts of the preceding muscle vary in their length, and consequently in the number of vertebræ with which they are connected. Their average extent is mentioned above.

The greater thickness of the cervical portion is dependent on the freedom of motion in that part of the column.

Multifidus spinæ

Multifidus spinæ.[15]—This long and narrow mass of muscular and tendinous fibres occupies the vertebral groove at the side of the spinous processes. It is fixed to the sacrum, and to all the vertebræ, except the atlas, covering them to a considerable thickness; some of its fibres (the deepest) reaching from one vertebra to the next, while others, placed

extends from sacrum to axis.

over those, extend to a greater distance. In conformity with the plan usually followed in the description of muscles, the origin and insertion of the fibres of this muscle may be stated as follows.

At the lower end the fibres arise from the strong aponeurosis covering the surface, from the groove on the back of the sacrum as low as the fourth aperture, from the inner part of the posterior superior iliac spine of the hip bone, and from the ligaments between this bone and the sacrum; in the lumbar region they take origin from the articular processes; in the dorsal region from the transverse processes; and in the neck from the articular processes of the four lower cervical vertebræ. From these several points the muscular bundles ascend obliquely, to be inserted into the laminæ of the vertebræ, and into the spines from the bases nearly to the extremities. The fibres vary in length; for those from each point of origin are fixed to several vertebræ—some to the next above, while others extend from the second even to the fifth beyond. Thus they are placed fibre over fibre, and each vertebra receives some from different points of origin, and of different lengths, the longest being necessarily most superficial. Origin of fibres. Their insertion. Various length.

Aponeurosis of the multifidus.—This aponeurosis is wide below where it covers the multifidus and the erector spinæ; but is narrow above and ends in two pieces—one for each part of the last muscle. Internally it is fixed to the spines of the sacrum and lumbar vertebræ; and externally it is inserted into the side of the sacrum, and the back of the iliac crest of the innominate bone—blending in the former situation with the sacro-sciatic ligament, and giving origin to the gluteus maximus muscle. Thus fixed, the tendon gives attachment, by the entire of its deeper surface, to a large part of the fibres of the muscles before mentioned; and its cutaneous surface is covered at the upper part by the vertebral aponeurosis, but at a lower point—over the sacrum—the two tendinous structures are united one with another, so as to be no longer separable. Aponeurosis of multifidus; attachments; gives origin to muscles.

Rotatores spinæ.—Under this name a series of eleven small, flat, nearly square muscles, have been described.* They are placed at intervals on the dorsal part of the spine, under the multifidus spinæ, from which they are separated by a little connective tissue. Each arises from the upper Rotatores spinæ. Number. Exist only on dorsal vertebræ.

* Prof. Theile in Müller's "Archiv. f. Anat.," &c., 1839.

and back part of the transverse process, and is inserted into the vertebra next above, at the inferior margin and on part of the surface, of the lamina, as far as the root of the spinous process. The first is situate between the first and second dorsal vertebræ, the last between the eleventh and the twelfth: but it not unfrequently happens that the number is diminished by the absence of one or more from the upper or lower end. The bundles of muscular fibres thus described as distinct muscles, do not appear to be distinguishable from the deeper part of the multifidus spinæ, except by the interposition of a little connective tissue.

Diminution of number.

Inter-spinales.

The *inter-spinales*[14] are short fasciculi of fleshy fibres, placed in pairs between the spinous processes of the contiguous vertebræ—as their name implies.

Cervical inter-spinal muscles.

They are best marked in the neck, where they are connected one to each of the two parts into which the spinous process is divided. Six pairs may be counted, the first being between the second and third vertebræ, the last between the seventh and the first dorsal.

Dorsal few and inconstant.

In the dorsal part of the column only a few of the interspinous muscles are met with, and these are not constant. They will not unfrequently be found between the first and second vertebræ of this region, and occasionally between the eleventh and twelfth. A vestige of them likewise sometimes exists in the second dorsal "interspinous" space.

Lumbar.

Four pairs of very thin layers occupy the intervals of the five lumbar vertebræ. One will likewise be found in some instances connecting the last of these vertebræ with the sacrum, and another joining the first with the dorsal vertebra above it.

Extensor coccygis occasionally present.

Slender muscular fibres have been mentioned as occasionally found to extend over the lower part of the sacrum and coccyx, apart from other muscles; and the name *sacro-coccygeus posticus*, or *extensor coccygis*, has been assigned them.* They arise by tendinous fibres from the first piece of the coccyx, or the last bone of the sacrum, or even at a higher point; and, reaching downwards, are fixed to the lower part of the coccyx. These have been considered a rudiment of the extensor of the caudal vertebræ of some animals.

Occasional fibres.

Coinciding with the peculiar conformation of the joint

* Günther and Milde, "Chirurgische Muskellehre," quoted in "Sömmerring von Baue," &c.

formed between the first two vertebræ, and the kind of movement which belongs to it, the deep-seated muscular structure between the axis and the occiput is found to differ widely in arrangement from that which has been met with over the rest of the vertebral column; here it is aggregated into small muscles, which are independent of each other, viz., the obliqui and recti, the "circumagentes" of some of the older anatomists. Arrangement of deep muscles near occiput.

Rectus capitis posticus major[10] (axoido-occipitalis). —This muscle extends from the spinous process of the axis to the under surface of the base of the skull. It *arises* by a tendinous origin from the process just mentioned; and, enlarging considerably as it ascends, passes over the atlas, and is *inserted* into and beneath the outer part of the inferior curved line of the occipital bone. It diverges from the corresponding muscle of the opposite side, so as to be much more oblique than straight, as the name would imply; and its insertion is beneath that of the superior oblique. Rectus posticus major; passes over atlas; is oblique.

The *rectus capitis posticus minor*[11] (alto-occipitalis) extends from the atlas to the base of the skull, being smaller every way than the preceding. It *arises* from the neural arch of the atlas by the side of the tubercle; expanding towards the other extremity, it is *inserted* into the inferior curved line on the occipital bone, and the rough surface between this and the foramen magnum. It lies nearer to the middle line than the preceding muscle at the occiput, and can therefore be seen without disturbing it. Rectus posticus minor; not concealed by former.

The recti muscles take the place of the inter-spinales. The smaller pair may be considered strictly corresponding; but the larger undergo a change in attachment and direction, referrible to the movements which they are required to effect. The latter do not remain on the atlas, for the movement of extension belonging to other parts of the spine does not exist between the first two vertebræ; and, moreover, their course upwards to the occiput, to which they are fixed, being oblique, they are calculated (besides the influence they exert in drawing the occiput backwards) to assist in the rotatory movements of which the axis is the pivot. Recti resemble inter-spinales; their use.

The *obliquus capitis inferior* v. major[12] (axo-atloideus), the largest of these muscles, is placed obliquely between the first two cervical vertebræ. It *arises* from the spinous process of the axis, between the origin of the rectus posticus Obliquus inferior, large comparative size.

major and the insertion of the semi-spinalis colli, and is *inserted* into the extremity of the transverse process (conjoined diapophysis and parapophysis) of the atlas.

Obliquus superior.

The *obliquus capitis superior*[13] (alto-post-mastoideus) extends from the atlas, where the preceding muscle terminates, to the lateral and inferior part of the base of the skull. It *arises* from the transverse process (diapophysis) of the first cervical vertebra, inclines from thence obliquely upwards and inwards, increasing somewhat as it ascends, and is *inserted* close behind the mastoid process, into the interval between the curved lines of the occipital bone.—

Intermuscular triangle.

The two oblique muscles, with the rectus major, form the sides of a small triangular space, in the area of which the posterior primary branch of the sub-occipital nerve and the vertebral artery will be found.

Muscles that extend and rotate the head.

Actions of the recti and obliqui.—The muscles that reach from the first vertebra to the occipital bone, viz., the rectus minor and the superior oblique, draw the head backwards, though the latter from the obliquity of its fibres may turn the face slightly to the opposite side. But the two remaining muscles passing from the fixed second vertebra or the axis draw towards that point, and rotate the atlas with the head around the odontoid process, so as to turn the face to the same side. After the head has been so rotated, the larger rectus may assist in extending the head.

Inter-transversales.

Inter-transversales (Cowper), (inter - transversarii, — Albinus).—These little muscles occupy the spaces between the transverse processes of the vertebræ; they are most developed in the neck, and least so between the dorsal vertebræ.

Cervical series.

In the cervical part of the spine there are in each space two rounded bundles of muscular fibres, with tendinous filaments intermixed, attached, one to the anterior, the other to the posterior transverse process (diapophysis and parapophysis), and separated from one another by the anterior primary branch of a cervical nerve. There are seven pairs in the neck, the first being between the atlas and axis, the last connecting the seventh cervical to the first dorsal vertebra.

Rectus lateralis, inter-transversalis.

The rectus lateralis (page 41), which extends from the transverse process of the atlas to the jugular process of the occipital bone, may well be regarded as an inter-transversalis; and the rectus anticus minor (page 41) might be considered its fellow — but displaced, as it were, forwards, to the anterior part of the vertebra.

In the loins the inter-transversales are four in number, one between each pair of vertebræ. Those connected with the lowest vertebræ are attached to nearly the whole of the transverse process, while those between the upper do not exceed half the breadth of the process. The muscles now described are in single layers; but the small round fasciculi which are stretched between the accessory processes of the lumbar vertebræ, and hence named *musculi inter-accessorii*, or *inter-obliqui*, may be looked on as rudiments of posterior inter-transversales. Lumbar. Inter-accessorii.

In the dorsal region narrow rounded cords are found between the transverse processes. They are tendinous in structure, except in the lowest three interspaces and in that between the last dorsal and first lumbar vertebræ, in which they are muscular. These fasciculi range with the inter-accessorii above described, at the same time they correspond with them in shape and size. Dorsal set are round cords; few muscular.

When proceeding with the dissection of the muscles last noticed, a series of fleshy and tendinous bundles — the "elevators of the ribs"—will be seen; these are extended downwards and forwards from the transverse processes of the vertebræ to the margins of the ribs. For their description see "Costal Region."

Combined action.—The *sacro-lumbalis*, *longissimus dorsi*, and *multifidus spinæ* combine in fixing the spinal column, and thereby maintaining the trunk erect. If they continue their effort the body will be drawn somewhat backwards, as may be observed when a considerable weight is suspended from the neck, or in persons who have become excessively fat. In both these cases the extensor muscles are required to make increased efforts to counterpoise the influence of the weight appended to the fore part of the body. Muscles maintaining trunk in erect position.

As these muscles have to sustain the trunk in the sitting as well as in the standing posture, it might be supposed that they scarcely admitted of any relaxation, and therefore were kept almost constantly in action. But it does not appear necessary, except in making great efforts, that all of them should be in action at the same moment, and even the different parts of the same muscle must, in most cases, act successively. Thus, the lower fibres of the multifidus spinæ pass from the lateral part of the sacrum to the lumbar spines, and materially assist the quadratus lumborum and other muscles in fixing the lumbar vertebræ. The lateral processes of these bones become the fixed points from which They alternate in action.

the succeeding parts of the multifidus act on the spines throughout the entire length of the column, so that a succession of efforts is propagated from below upwards by a sort of vermicular motion; and the action of one set of fibres succeeding that of another, each will have its alternations of contraction and relaxation.

They bend the trunk laterally.

The sacro-lumbalis can draw down the lower ribs; and if the effort be continued, this influence must speedily be propagated to the spinal column which is thus bent towards the side by means of the intimate connection between the heads of the ribs and the vertebræ. The longissimus dorsi conspires to produce the same effect.

Rotatory movement of the spine.

The spine admits, to a certain extent, of a rotatory movement. Thus the head may be carried round by a horizontal motion, until the chin comes nearly on a line with the point of the shoulder; after which the spine may be made to turn on its own axis, until the face shall have completed almost a semicircle from the point at which its first movement began. The latter movement is effected by that peculiar action of the multifidus spinæ above alluded to; but it is the muscle of the opposite side from that towards which the movement takes place that produces the rotation, assisted by the obliquus externus abdominis.

Action on ribs.

The influence of the sacro-lumbalis, in depressing the lower ribs, must be evident from its mode of attachment to them. But its accessory muscle (cervicalis ascendens), by taking its fixed point at the cervical vertebræ, is enabled to draw up, and therefore elevate the ribs into which it is inserted.

MUSCLES OF THE UPPER EXTREMITY.

The muscles of the upper extremity may be divided into four groups, viz., those placed on the shoulder, on the arm, on the fore-arm, and on the hand. The description of the moving powers of the limb may be begun with that of the two pectoral muscles and the serratus magnus.

Dissection of pectoral muscles;

Dissection of the upper arm.—The body being laid on its back, and the arm drawn away from the side, an incision may be made through the skin, commencing at the middle of the clavicle, and extending down to the centre of the axilla. From this another line may be drawn, downwards and inwards, along the lower border of the pectoralis major. The angular flap thus included should then be raised from off the muscle just named, its dissection being conducted from without inwards to the fore part of the sternum, so as to expose the muscle. It

may be necessary to make another incision through the skin, along the clavicle, to the sternum, from the point above indicated. The external flap of the skin may then be dissected off the remainder of the pectoral muscle, and part of the deltoid. When the external surface of the pectoralis major has been examined, it may be detached easily by drawing forwards its lower border, and inserting the scalpel between it and the costal cartilages, and cutting through its attachments to them, as well as to the sternum and clavicle, successively. The muscle may then be drawn outwards, and the fold in its tendon examined. The pectoralis minor is thus exposed, and the axillary vessels partly. The costal attachment of this muscle may be separated in the same way as the other. The axillary vessels are by these measures brought fully into view, little else remaining to be done than to remove the fatty tissue in which they are imbedded. For the Axillary Artery, the Vein, and the Plexus of Nerves, see the account of those structures.

When commencing the dissection of the arm, an incision may be made from the middle of the interval between the folds of the axilla, and thence drawn down to the middle of the space between the condyles of the humerus. This indicates the course of the brachial artery. It should barely divide the skin, care being taken not to injure the fascia beneath it. It will be found convenient to bound it below by a transverse incision; after which, the skin may be cautiously raised from the fascia all round the arm. In order to expose the deltoid, it will be necessary to make an incision through the integument, commencing at the external third of the clavicle, and extending along the acromion and spine of the scapula; after which, it may be dissected off the muscle, proceeding from above downwards and outwards, until the whole flap of skin is removed. When the muscle has been examined, it may be easily detached from its origin, and reflected down on the arm, by inserting the scalpel under its posterior border, and cutting from within outwards, close along the margin of the spine of the scapula, and so successively along the acromion and clavicle. This will expose the circumflex vessels and the external rotator muscles.

of the front of the arm;

of the deltoid

The fascia of the arm may in the next place be divided, and reflected in the same way as the integument. In doing so, care should be taken not to injure the internal cutaneous nerve. As the fascia is being reflected, the biceps muscle and the brachial artery and the nerves, except the circumflex and spiral, are brought into view: their relative position, particularly at the bend of the arm, should be attentively considered. If the arm be rotated outward, the direction of the spiral nerve and profunda artery can easily be traced for some way between the heads of the triceps muscle. At the outer side of the arm, the nerve will be found in the deep sulcus between the brachialis anticus and supinator longus, after it has made its turn behind the humerus. The external cutaneous nerve has also to reach the external side of the arm, but it runs in front of the humerus, piercing the coraco-brachialis muscle, and then lying between the biceps and brachialis anticus.

of the biceps; and vessels and nerves;

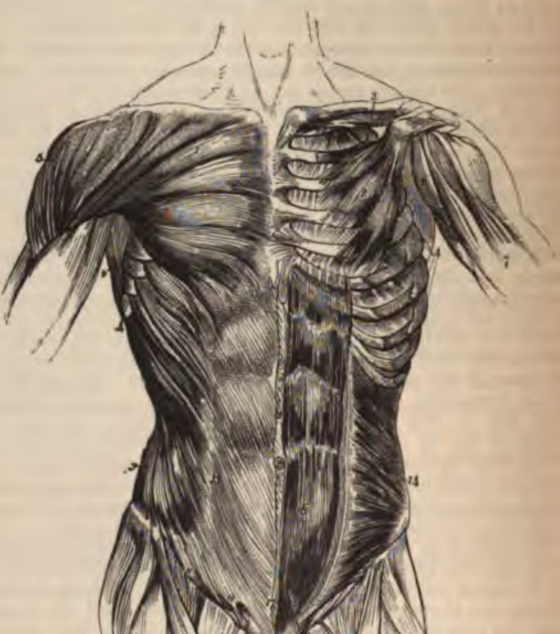
The examination of the triceps had better be conducted from below upwards, and, when its three heads have been carefully traced out, a longitudinal incision may be made through the substance of the muscle: after which, when the two parts are drawn back, the manner in which the fleshy fibres proceed to its tendon or aponeurosis from the bone will be distinctly seen.

of triceps.

THORACIC REGION (ANTERIOR).

The *pectoralis major* (fig. 113,[1]) (pectoralis; sterno-costo-

Fig. 113.*



Pectoralis major narrows towards arm.

clavi-humeralis) is placed on the anterior and upper part of the thorax, and in front of the axilla. It is broad and ex-

* From the right side the integuments only were removed; from the left the greater pectoral muscle and the external oblique, with the anterior part of the sheath of the rectus abdominis, were taken away. 1. Greater pectoral muscle. 2. The smaller pectoral. 3. Subclavius. 4. Serratus magnus. 5. Deltoid. 6. Coraco-brachialis. 7. A part of the biceps. 8. Latissimus dorsi. 9. External oblique of abdomen. 10. The external abdominal ring. 11. Poupart's ligament. 12. Linea alba. 13. Aponeurosis of the external oblique. 14. Internal oblique. 15. Cremasteric fibres on the spermatic cord. 16. Rectus abdominis. 17. Pyramidalis.

panded in the former situation, narrowing gradually towards the latter, and *arises* from the sternal half, or a little more, of the clavicle; from the anterior surface of the sternum, extending as far down as the insertion of the cartilage of the sixth rib; from the true ribs, except the last, being attached to the cartilages, and to the bony part as well of the sixth; and from the aponeurosis of the external oblique muscle of the abdomen. From this extensive origin the fleshy fibres proceed, converging towards the tendon of insertion; those from the clavicle, which are usually separated from the rest by a narrow interval, pass downwards and outwards; those from the lower cartilages obliquely outwards; the middle set horizontally. The muscular fibres become continuous with those of the tendon, and still retain their original direction as they proceed to their respective points of insertion into the humerus; and as the superior fibres descend, whilst the inferior ones ascend, the latter passing behind the former, the muscle is folded, the middle of the fold being along its axillary border. The tendon about two inches wide is folded on itself, like the muscle, and is fixed into the anterior or outer margin of the bicipital groove of the humerus; from it an extension is continued across the groove, lining this; and two other offsets are prolonged, the one upwards and the other downwards, to the head of the bone and the fascia of the arm. The tendon is likewise connected at its insertion with that of the deltoid muscle.

Origin.

Muscle and tendon folded.

Insertion.

Structure :—The muscle is aponeurotic at its internal and external attachments, and fleshy in the rest of its extent.

At the sternal origin the aponeurotic fibres of the muscle decussate sometimes with those of its fellow in front of the sternum. The inferior border overlaps the serratus magnus; and the superior runs parallel with that of the deltoid muscle, from which it is separated only by the cephalic vein and a small artery. The anterior surface is subcutaneous in the greater part of its extent, being covered only by some of the fibres of the platysma myoides, and by the mamma. The posterior surface, besides the sternum, clavicle, and ribs, covers the pectoralis minor, subclavius, and serratus magnus muscles, as well as the axillary vessels and nerves. The lower border of this muscle is at first separated from that of the latissimus dorsi by a considerable interval, in which may be observed the fibres of the serratus magnus; but both gradually converge towards the axilla, forming its folds or borders.

Parts adjoining.

Separated from deltoid by vessels.

Covers axillary vessels.

Forms fold of axilla.

Peculiarities. The interval on the sternum between the muscular parts of the right and left pectoral muscles varies in different cases. In bodies which afford examples of large muscular development, they are separated only by a narrow groove. One or two muscular slips, taking rise from the aponeurosis of the external oblique muscle, are occasionally added to the lower margin of the pectoral muscle; and, on the contrary, a deficiency may be met with in the same situation. This was, in one case, found to be so extensive as to amount to the absence of all except the clavicular part of the muscle.*

Pectoralis minor. *Pectoralis minor* (fig. 113,[2]) (serratus anticus, — Alb.; costo-coracoideus).—The smaller pectoral muscle lies at the superior part of the thorax, covered by the preceding muscle, and extended obliquely across the axilla. Origin. It *arises* from the upper margin or the upper margin and external surface of three ribs, usually the third, fourth, and fifth, near their cartilages, as well as from the aponeurosis over the intercostal muscles; the origin being somewhat notched or serrated, Is serrated. so that by some of the older anatomists the muscle was named from that circumstance. The fleshy fibres, as they proceed obliquely upwards and outwards, converge to a narrow tendon, Insertion. which is *inserted* into the anterior half of the slanting upper surface of the coracoid process, and is joined to the origin of the coraco-brachialis and the biceps muscle from the same process.—The anterior surface is covered by the pectoralis major, the posterior crosses the axillary vessels and nerves. Covers axillary vessels.

Subclavius. The *subclavius muscle* (fig. 113,[3]) (costo-clavicularis) is, as the name implies, placed under the clavicle, in the interval between this and the first rib. Origin. It *arises* by a short thick tendon from the first rib, at the junction of the osseous and cartilaginous parts, and close to the rhomboid ligament; from this spot it is directed outwards beneath the clavicle, forming a rounded fleshy fasciculus, which is *inserted* Insertion. into the grooved and rough surface along the costal aspect of the clavicle.—The upper surface is covered by the clavicle, a small part beneath it being overlapped by the pectoralis major, but the muscle is not at first perceptible, until a dense fascia that covers it is dissected off; the costal surface lies in front of the subclavian vessels as these pass down from the neck. Is over subclavian vessels.

THORACIC REGION (LATERAL).

Serratus magnus. The *serratus magnus* (figs. 111,[10] 113,[4]) (costo-basi-scapu-

* See the work on Arteries before cited, p. 233.

n the surface of the first eight ribs, two of the being connected with the second rib ; and oppo-rst as well as a few other intercostal spaces, fibres 'ed from slender tendinous structures over the intercostal muscles. From this extensive origin, of the muscle, forming a thin stratum, and s they proceed backwards over the convexity of are inserted into the base of the scapula on its costal aspect, being interposed between the sub- on the one side and the rhomboidei and levator pulæ on the other.

ive insertion on an extent of surface so much less t from which they arise, the fibres converge ; but convergence is not uniform, and the fibres are arranged at the upper, middle, and lower ends, s of the muscle are recognised as follows. *a*. The m the first and second digitations form a narrow band, which terminates on the impression at the face of the scapula immediately below the upper . Those of the third and fourth digitations spread a thin layer (the thinnest part of the muscle), upies the scapula from the preceding part nearly ver angle of the bone.—Much the larger portion ıe middle division of the muscle, is formed by the gitation, which expands into a triangular piece. the five remaining digitations which are received ıes in the external oblique muscle of the abdomen, ular structure converges to a thick and partly mass, and is inserted at the lower angle of the n the inner surface.

Arranged in three parts on scapula.

posticus superior. The other is subcutaneous in the angular interval between the pectoralis and latissimus dorsi; higher up it is covered by both the pectoral muscles; in the rest of its extent it is in relation with the subscapular muscle and the axillary vessels.

Peculiarities.

Not unfrequently the number of digitations, and the number of the ribs with which the muscle is connected, are augmented by one or two; and occasionally the attachment to the first rib is wanting. Examples are recorded of the absence of the thin middle part of the muscle, and some other peculiarities of minor importance, *e. g.* the presence of additional muscular bands, have been noticed.

Action of pectoralis major;

Combined actions.—The most obvious actions of these muscles are exerted upon the shoulder and arm, as being their more moveable points of attachment. The *pectoralis major*, conjointly with the latissimus dorsi and teres major, depresses the humerus, if this has been previously elevated; it then conspires with them in pressing the arm closely to the side, and, continuing the same effort, will by itself trail the limb along the side and front of the chest. The *pectoralis minor* draws the point of the shoulder downwards and inwards to the thorax. If the arms be fixed, these muscles act on the ribs and assist in dilating the chest. This is frequently observed during the forcible efforts at inspiration made by asthmatic persons; in them the arms are rendered fixed, by seizing hold of some object, and then every muscular effort which can elevate the ribs, is called into play.

pectoralis minor;

and serratus magnus.

When the scapula is rendered fixed by the trapezius and rhomboid muscles, the *serratus* acts on the chest in the same way as the pectoral muscles do; but its most ordinary action is to draw the base and inferior angle of the scapula forwards, so as to elevate the point of the shoulder by means of the rotatory motion it can impress upon that bone, conjointly with the trapezius, as before stated when treating of the latter muscle. The continuation of the same effort retains the shoulder elevated, as when a burden is sustained upon it; but, as a preparatory measure, the thorax must be fixed. Whilst any important muscular exertion is being performed, the thorax must be fixed, and retained so by preventing the escape of the included air. This may be inferred from observation on what takes place under such circumstances, but was reduced to the test of experiment by M. Bourdon.* He opened the trachea, or larynx, of a dog

Power increased when the ribs are fixed.

* Mémoire sur les Efforts.

that had been in the habit of jumping and tumbling when bidden; after which, the animal was no longer able to make any similar efforts, though evidently willing to do so. But when the aperture was closed by drawing the margins of the wound together, the lost power was instantly restored.

ACROMIAL REGION.

The *deltoid muscle* (fig. 113,[b]) (deltoides; sub-acromio-humeralis) is situate at the superior and external part of the arm, covering the shoulder-joint over which it is curved. Its form is triangular, the base above, and the apex below, and resembles the shape of the Greek letter Δ reversed, from which circumstance the muscle has been named. **Deltoid; curves over shoulder.**

It *arises* from the external third of the clavicle, from the lower border of the acromion, and from the edge of the spine of the scapula, nearly as far back as the small triangular surface in which this process terminates; and is *inserted* into the triangular rough surface above the middle of the outer side of the humerus, for a distance of about three inches. At its origin the deltoid is tendinous and fleshy, but at the back part of the spine of the scapula it is only tendinous. Moreover, the surface of origin is much increased by means of processes of fibrous structure, which extend from the acromion downwards through the muscle, and give rise to fleshy fibres. Its lower end is muscular on the cutaneous surface, and its deeper part is formed by a thick tendon. The whole appearance of the muscle is coarse, the muscular bundles being separated by broad and deep interspaces. **Origin. Insertion. Tendinous bands for origin of musc. fibres.**

As the fibres converge, they necessarily have different directions. All are directed downwards;—those in the middle vertically; those from before and behind obliquely, the former being inclined backwards, the latter forwards.

The deltoid is separated from the integuments by a thin layer of fascia, with a portion of the platysma and a few nerves. It covers the circumflex vessels and nerve and the upper part of the humerus; the coracoid process with the pectoralis minor, coraco-brachialis and biceps; the subscapularis, the coraco-acromial ligament, the external rotator muscles, over the triceps. Between it and the scapular muscles over the head of the humerus is a large sacculated bursa interposed. The anterior border is in contact with the pectoralis major, from which it is partly separated by **Parts adjacent.**

the cephalic vein ; and the posterior border is bound down by fascia. At its insertion the anterior part of the tendon is blended with the great pectoral.

Subdivisions of the muscle.

From the manner in which the tendinous structure is mixed with the fleshy fibres of this muscle at its middle, several subdivisions are to be recognised. Albinus * points out seven portions arranged into two orders. The first order consists of four parts, which are each characterised by being broad at the upper end, and narrowing downwards. Two of these, which are large, constitute the anterior and posterior parts of the muscle, and occupy, one the clavicle, the other the spine of the scapula ; the two smaller are connected with the acromion. The second order consists of three slender parts : they are interposed between the former, and are distinguished from those by being narrow at the upper part of the muscle, where they begin as tendinous bands.

The arrangement here pointed out appears to resolve itself into the facts before indicated, namely, that most of the muscular fibres are derived from the bones directly, or from a short tendinous structure ; and that tendinous bands descending from the acromion at intervals divide these fibres into parts (the first order of Albinus), and give origin to other fibres at some distance downwards (the second order of the same author). It should be added, that the arrangement of the fibres does not in all cases conform with the description of Albinus, though the general character is the same.—The extent to which the muscle reaches on the humerus varies in different persons.

SCAPULAR REGION (POSTERIOR).

Supra-spinatus.

Supra-spinatus (fig. 111,[12]).—This muscle is placed at the superior part of the shoulder, in the supra-spinous fossa of the scapula. Its form is elongated and triangular. It

Origin.

arises from the fossa above mentioned, as far forwards as the root of the spine, from the upper surface of that bony process, and from the fascia covering the muscle : the muscular fibres converge to a tendon in their middle, which

Insertion.

adheres to the capsule of the shoulder-joint, and is *inserted* into the upper of the three surfaces on the greater tuberosity of the humerus.

Parts over and under.

The supra-spinatus is covered by the trapezius, coraco-acromial ligament, and deltoid. It lies on the scapula and supra-scapular nerve and vessels ; it covers part of the fibrous capsule of the shoulder-joint, with which it is intimately united.

* The mode of considering the structure of the muscle, or the facts on which it was founded, appear to have been suggested by Douglas in personal communication with Albinus.—See the "Histor. muscul. hom." p. 423.

The *infra-spinatus* (fig. 111,[13]) occupies the chief part of the infra-spinous fossa, and is triangular in shape. It *arises* from the lower surface of the spine of the scapula, and from the infra-spinous fossa, except at the lower angle and along the anterior border where the teres muscles lie. The fibres converge to a tendon, at first concealed in a great degree within the substance of the muscle, which proceeds forwards over the capsular ligament of the joint, to be *inserted* into the middle facet of the great tuberosity of the humerus. The superior fibres are nearly horizontal, the inferior ones ascend obliquely to meet them. Infra-spinatus. Origin. Insertion.

The posterior surface is covered partly by the deltoid, the latissimus dorsi, and the trapezius, a small part being separated from the integument only by the fascia. The anterior one rests on the bone, (vessels and nerves being interposed,) and the capsular ligament, to which it is intimately adherent. The lower border is in contact with the teres minor, with which it is sometimes united, and with the teres major. Structures adjacent.

The *teres minor* (fig. 111,[14]) lies along the inferior border of the scapula; its form is elongated, narrow, and rounded. It *arises* by a series of oblique fibres from a special surface on the dorsal aspect which surmounts the axillary border of the scapula; and from two aponeurotic septa, placed between it and the infra-spinatus and teres major muscles. Its *insertion* is by tendon into the greater tuberosity of the humerus, immediately below that of the infra-spinatus, and by fleshy fibres into the bone beneath. Teres minor. Origin. Insertion.

The teres minor is covered by the integuments and the deltoid muscle. It rests on the scapula, (the dorsal branch of the sub-scapular artery coursing beneath it,) the long head of the triceps muscle, and the fibrous capsule of the shoulder-joint to which it adheres like the preceding muscles. The upper border lies in contact with the infra-spinatus; the lower with the teres major, from which it is separated anteriorly by the long head of the triceps. The posterior extremity is inserted between the teres major and infra-spinatus, being connected with both, as has been above stated. Parts adjacent.

The three flat surfaces marked on the upper part of the great tuberosity of the humerus give insertion to the three muscles last described, taken in their regular order from above downwards.

The *teres major* (fig. 114,[1]) extends from the inferior angle Teres major.

of the scapula to the humerus, contributing to form the posterior border of the axilla. It is rather broad and compressed than round or tapering, as its name would imply.

Origin. It *arises* from the flat expanded surface at the inferior angle of the scapula on the dorsal aspect, from the axillary border of the bone, and from the septa interposed between it and

Insertion. the teres minor and infra-spinatus. The *insertion* takes place by a flat tendon about two inches wide, into the posterior border of the bicipital groove in the humerus, and is in close contact with the tendon of the latissimus dorsi. The direction of the muscle must necessarily vary according to the different positions of the scapula and humerus. Towards their insertion the fibres of the teres major appear to descend somewhat, whilst those of the latissimus ascend, so that the margin of the former is placed lower down than that of the latter muscle.

Adjacent structures. This muscle is covered by the latissimus dorsi and the integument, and is crossed by the long head of the triceps, which separates it from the teres minor. The anterior surface, in part of its extent, is in contact with the latissimus (in consequence of the change of direction of the latter), and slightly with the axillary vessels and nerves. There are two bursæ at its insertion, a large one in front between it and the latissimus, and a small one behind between it and the bone.

SCAPULAR REGION (ANTERIOR).

Sub-scapularis. *Sub-scapularis* (fig. 114,[2]).—The sub-scapular muscle, triangular in form, fills up the hollow of the scapula, lying

Origin. between that bone and the thorax. It *arises* from all the sub-scapular fossa, with the exception of the neck of the bone, and of two spaces at the upper and lower angles which are occupied by the serratus magnus; a portion of the muscle is likewise derived from slender tendinous laminæ intersecting it and connected with the ridges on the bone. From this extensive origin the fibres are directed outwards, converging and augmenting the thickness of the muscle, and end in the tendon of insertion, as well as in several elongations of it, which penetrate deeply into the substance of the muscular structure. The tendon is attached to the small tuberosity of the humerus; whilst the fleshy fibres that arise

Insertion. near the axillary border of the scapula are fixed separately into the neck of that bone, for an inch below the tendon.

Parts adjacent.

The sub-scapular muscle is very deeply placed. It is in contact by the outer surface with the scapula and the capsule of the shoulder-joint; and, by the inner or anterior surface, with the serratus magnus, with the coraco-brachialis and biceps, and with the axillary vessels and nerves. The upper margin is close to the coracoid process of the scapula, and a synovial membrane is usually found between them.

Fig. 114.*

A band of muscular fibres, from two to three inches in length, is sometimes found extending from the scapula to the neck of the humerus immediately below the sub-scapularis.

Elevators of the humerus.

Actions.—The *deltoid* can raise the arm directly from the side, so as to bring it at right angles with the body; after which, by means of its anterior and posterior fibres, it can carry the limb alternately backwards and forwards, being assisted in the former movement by the teres major and latissimus dorsi, in the latter by the pectoralis major. The mass of its muscular fibres is so considerable, that it is enabled, by pressing down the head of the humerus, to make this glide upon the surface of the glenoid cavity of the scapula; and then, by continuing to act, to raise the limb directly upwards, so as to bring it to a vertical position. Its only assistant in elevating the arm is the *supra-spinatus*, whose power in this respect must be trivial, as it is inserted so near the centre of motion.

Rotators.

The *infra-spinatus* and *teres minor* will act as external rotators of the arm, provided the humerus hangs vertically, and the sub-scapularis will rotate it inwards; for as they are opposed in situation, so they are antagonists in action. The power of these muscles is increased in no small degree by passing over the globular head of the humerus, and also

* Muscles of the left shoulder and arm. 1. Teres major. 2. Sub-scapularis. 3. Coraco-brachialis. 4. Biceps brachialis. 5. Brachialis anticus. 6, 7, 8. Triceps.

by being inserted into the prominent processes of bone which remove the line of their direction to a distance from the axis of the humerus.

Depressors. The *teres major* conspires with the latissimus dorsi in its actions; it depresses the arm, if raised, and rotates the limb on its axis. If the arm be fixed, as when in the reclining posture the elbow is removed from the side, these muscles, particularly the teres major assisted by the long head of the triceps, can approximate the lower border of the scapula to the shaft of the humerus, thus combining with other muscles, viz. the pectoralis and latissimus dorsi, to trail the body after the out-stretched limb.

HUMERAL REGION (ANTERIOR).

Coraco-brachialis. *Coraco-brachialis* (perforatus,—Casserius *) (fig. 114,[3]).—This, the smallest muscle of the upper arm, is placed along the superior and inner part of the humerus for about half its length. Attachments. It *arises* from the tip of the coracoid process of the scapula, between the pectoralis minor and the short head of the biceps; also from the tendon of the latter, with which it is intimately united for some way. The fleshy fasciculus thus formed passes downwards and a little outwards, to be inserted into the inner border of the humerus about the middle, where it is interposed between the brachialis anticus and the triceps. Structure:—aponeurotic at its attachments, fleshy in the middle.

Connections. The anterior surface of this muscle is covered above by the deltoid and pectoralis major; and at its insertion it is crossed by the brachial artery. The posterior surface lies over the tendon of the sub-scapularis, and those of the latissimus dorsi and teres major. One border is in apposition with the biceps, the other with the brachial artery. From its insertion a tendinous offset is prolonged upwards to the head of the humerus. The muscle is usually pierced by the musculo-cutaneous nerve.

Biceps. The *biceps* muscle (fig. 114,[4]) (biceps flexor cubiti; coraco-scapulo-radialis) lies along the anterior part of the arm for the entire length, extending from the scapula to the fore-arm. Superiorly it is divided into two heads, whence its name is derived. Short head. Of these, the internal or short head arises con-

* "Tabulæ Anatom." edited by Daniel Bucretius (Rindfleisch), tab. 19 and 20. The name has reference to the perforation by the musculo-cutaneous nerve.

jointly with the coraco-brachialis from the coracoid process of the scapula by a tendon, which spreads out and gives origin to the muscular fibres. The external or long head commences by an elongated and rounded tendon, which springs from the upper angle of the glenoid cavity of the scapula, and is continuous with the glenoid ligament. The tendon passing immediately over the head of the humerus, covered by a special tube of the synovial membrane of the joint, pierces the fibrous capsule at the humeral attachment, and, after descending some way in the groove of the bone appropriated to it, spreads into an expansion from which the muscular fibres take their rise. The fleshy fibres of the two heads join and form what is named the belly of the muscle, which is narrow and somewhat flattened, and ends above the bend of the elbow in the tendon of insertion. This sinks between the muscles of the fore-arm, to be inserted into the posterior part of the "bicipital" tuberosity of the radius; from the anterior part of which process it is separated by a synovial bursa. The tendon is at first broad and thin, but it gradually narrows, and when approaching the radius is twisted on itself, so as to be applied by a flat surface to the bone on which it ends. At its commencement a fibrous expansion, presenting an arched border, is sent off from the tendon, and this process passes obliquely downwards and inwards, and becomes blended with the fascia of the fore-arm somewhat below the inner condyle. The expansion is stretched across the brachial artery, median nerve, and part of the pronator teres muscle.

Long head.

Tendon of insertion.

Expansion from tendon covers artery.

The anterior surface of the muscle is overlapped superiorly for some way by the deltoid and pectoral muscles; but in all the rest of its extent it is covered only by the integument and fascia, with the exception however of the lower tendon, which sinks deeply between the muscles, and at its termination corresponds with a notch in the margin of the supinator brevis. The posterior surface, for about half its length, lies on the humerus and shoulder-joint; and in the rest on the brachialis anticus, being separated from the latter by the musculo-cutaneous nerve. The inner border is in contact with the coraco-brachialis for one half its length, and with the brachial artery for the other. The connection of the long tendon of origin with the shoulder-joint has been sufficiently noticed (Vol. i. p. 207).

Parts adjacent.

Brachial artery along inner side.

A third head, taking origin from the humerus, is occasionally added to this muscle. The fibres are usually more or less blended at their

An additional "head" to the muscle.

origin with the brachialis anticus, or arise between it and the lower end of the coraco-brachialis; and they were, therefore, considered by Albinus to be an offset from that muscle to the biceps. The added part, which is sometimes equal to half the size of the coraco-brachialis, joins the biceps at its posterior and inner side near the tendon, and lies outside the brachial artery; but in some instances such an accessory piece is found crossing over the artery. A muscular band has been observed to extend in the opposite direction to the foregoing, viz. from the biceps to the inter-muscular septum above the inner condyle of the humerus. This had the appearance of a second coraco-brachialis, and lay over the brachial artery.*

Unusual insertion to humerus.

Brachialis anticus.

Brachialis anticus (brachialis internus,—Douglas and Albinus; humero-cubitalis) (fig. 114,[5]).—This muscle lies under cover of the biceps, along the lower half of the arm. In form it is somewhat compressed, and is broader in the middle than at the extremities. It *arises* from the fore part of the humerus, commencing at the insertion of the deltoid, which it embraces by two angular fleshy processes, and extending to the capsule of the elbow-joint: some fibres arise largely from the inner inter-muscular septum, but only sparingly from the outer, viz. for about one inch and a half above. After passing in front of the elbow-joint, the muscular portion ends in a thick fasciculus of tendinous fibres, which is *inserted* into the rough surface on the fore part of the coronoid process of the ulna, where it is received into a notch at the upper end of the flexor digitorum profundus. The middle fibres are vertical, those on each side converge a little to them.—The posterior surface rests on the bone and capsular ligament; the anterior, partly concealed by the biceps, projects somewhat at each side of it, and supports the brachial artery and median nerve.

Origin.

Notched for deltoid.

Insertion in notch of flexor profundus.

Some fibres from the middle of the brachialis anticus, have been found to pass in an unusual direction inwards over the brachial artery to be connected with the internal inter-muscular septum. See the work referred to for peculiarities of the biceps, vol. i. p. 271.

Action of biceps and brachialis anticus.

Combined actions.—The most obvious action of the biceps is that of flexing the elbow, in which it conspires with the brachialis anticus; it also serves to render tense the fascia of the arm by means of the process which connects its tendon with that membrane. If the hand be placed in the prone position, the biceps can turn it supine, being in this particular the direct antagonist of the pronator radii teres. When the fore-arm is rendered fixed by holding some firm object, the

* See a Treatise on Arteries, before cited, page 270, and plate 57.

biceps and brachialis muscles can draw on the humerus, and bend it forwards on the fore-arm, as is exemplified in the effort of climbing. They can also move the humerus on the scapula; but their influence in this respect must be very limited, as they run parallel with the axis of the bone. When the humerus is fixed, these muscles, by drawing on the coracoid process, move the scapula and therefore the glenoid cavity on the head of that bone, so that the humerus may receive support from the latter, rather than that it should be solely pressed up against the articular surface.

HUMERAL REGION (POSTERIOR).

The *triceps cubiti*,—Douglas; triceps brachii,—Alb. (fig. 115), the only muscle that lies behind the bone and inter-muscular septa, rests against the posterior surface of the humerus in the entire length, and extends from the lower border of the scapula to the upper extremity of the ulna. Superiorly it is divided into three processes or heads, whence its name is derived, whilst its lower half, or more, is single and undivided. The *middle head* [1] arises from the lower part of the glenoid cavity and an adjoining rough portion of the inferior costa of the scapula, by a tendon which spreads over the sides of the muscular structure to whose fibres it gives origin. The muscular fibres from this source, passing downwards between those of the other two parts or heads, end by joining with them below in the common tendon of insertion. The *external head* [2] takes origin by tendinous and fleshy fibres from the humerus immediately below the great tuberosity, where this gives insertion to the teres minor, and from the surface of the bone below that point: likewise from the ridge above the external condyle, together with the external intermuscular septum. The fibres proceeding from this Triceps.

Fig. 115.*

Middle, or long head.

External head.

* The triceps muscle seen from behind. The scapula has been raised from its ordinary position.

extended origin follow different directions to terminate in the common tendon. The *internal head*,[3] placed to the inner side, and derived likewise from the humerus, commences by muscular fibres having a narrow and pointed form, behind the tendon of insertion of the teres major, as well as from the inter-muscular septum above the inner condyle, and from the posterior surface of the humerus; the fibres are directed, some immediately to the olecranon, the rest to the general tendon of insertion.

Internal head.

Tendon of insertion.

The tendinous structure on which the large mass of muscular fibres is received inferiorly, consists of two strata. One of these which is subcutaneous, covers the muscle to a considerable extent, and is the cause of the flatness above the elbow which is especially apparent when the muscle is put into action: the other is placed deeply. Both, after giving insertion to the muscular fibres and joining together above the olecranon, are fixed to the posterior and upper part of that process.

Parts adjacent.

The long head of the triceps lies between the two "teres" muscles, and is in contact with the capsule of the shoulder-joint. The muscle is separated from the bone by the musculo-spiral nerve and the superior profunda vessels, which correspond with a groove before noticed and are covered by slender fibrous structure. It is separated, at each side of the bone, from the muscles in front of the arm by the inter-muscular septa connected with the ridges above the condyles of the humerus. The lower part covers the elbow-joint; and between the tendon and the top of the olecranon is interposed a synovial bursa which in some instances is multilocular.

Synovial bursa.

Different view of origin.

M. Theile * limits the origin of the outer head of the triceps muscle to the part of the humerus above the spiral groove for the musculo-spiral nerve; and this anatomist assigns to the inner head all the fibres given from the posterior surface of the bone below that groove, as well as those from the ridge above the external condyle of the humerus.

Sub-anconeus is part of triceps.

Sub-anconeus.—On removing the triceps from the lower part of the humerus, some muscular fibres will be found connected with the capsule of the elbow-joint. Two slips extending to the capsule from the bone above the fossa for the

* Müller's "Archiv." &c. 1839. S. 420, and "Sœmmerring v. Baue," &c.

olecranon have been described as distinct from the triceps, under the name *sub-anconeus.** These fibres are analogous to the sub-crureus, which occupies a corresponding place in the lower limb.

Actions.—When the elbow-joint is flexed, the triceps, by drawing on the extremity of the ulna, is enabled to extend it on the humerus, and so bring both parts of the limb into a right line. In situation, as well as in action, it is thus the direct antagonist of the biceps and brachialis anticus. When the arm is in the extended position, the long head of the triceps may assist, in some degree, the teres major and latissimus in carrying it backwards. If the elbow be fixed the scapula becomes relatively the more movable point of attachment of the muscle; and then the long head, by acting on the lower border of the bone, can approximate this to the shaft of the humerus. **Action of the triceps.**

MUSCLES OF THE FORE-ARM.

The muscles of the fore-arm are very numerous, and their relations complex; and to make the examination of them more facile, they may be divided into different regional groups. Two of these groups lie in front of the limb on the sides of the tendon of the biceps muscle and the brachial vessels, as these dip down at the bend of the elbow-joint, one being on the inner or ulnar, the other on the outer or radial side;—the former being attached to the internal condyle of the humerus, the latter to the external. Another set of muscles which admits likewise of subdivision, occupies the posterior aspect of the limb. **Groups of muscles of the fore-arm; outer and inner.**

BRACHIAL REGION (INNER AND ANTERIOR).

The muscles on the front and inner part of the fore-arm are disposed in two sets, one being superficial, the other deep-seated.

The *dissection* of the fore-arm may be commenced by making an incision through the skin, from the middle of the interval between the condyles of the humerus to the root of the thumb; this marks out the course of the radial artery, and may be bounded by a transverse incision at each extremity. If the integument be drawn tightly forwards, **Dissection of fore-arm.**

* Theile in "Sœmmerring v. Baue," &c.

and reflected inwards, the cutaneous veins and nerves may be seen running in the subcutaneous tissue between it and the fascia; and, when once found, there can be little difficulty in tracing them in their entire extent, as they can be made to rest on the fascia, which gives them a firm support, whilst the scalpel is carried from above downwards along their cutaneous surface. After the superficial nerves and veins have been examined, the fascia may be dissected off the muscles. The examination of the muscles should be conducted in the order in which they are described, commencing with those attached to the inner condyle.

Superficial muscles;

In the *superficial layer* of muscles are the pronator radii teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, and flexor digitorum sublimis. These are all intimately united at their origin from the inner condyle, to which they are attached by a *common tendon* that gives a fasciculus of fibres to each, and also sends septa between them.

their common tendon.

Fig. 116.*

Pronator teres.

Pronator teres, — Douglas and Albinus; pronator radii teres,— Cowper (fig. 116,[1]).—This muscle is extended obliquely across the front of the arm at the upper third. It *arises* by two distinct heads; one, large and superficial, is derived from the upper part of the inner condyle of the humerus, and the common tendon above mentioned; also from the fascia of the fore-arm, and the septum between this muscle and those nearest to it. The second head, a thin fasciculus deeply placed, comes from the inner margin of the coronoid process, and joins the other at an acute angle, being previously separated from it by the median nerve. The fleshy belly thus formed proceeds outwards and downwards, and ends in a flat tendon which turns over the radius, and is inserted into a rough surface at the middle of the outer side of that bone.

Origin in two parts, which are separated by median nerve.

* The superficial muscles of the left fore-arm. 1. Pronator teres. 2. Flexor carpi radialis. 3. Anterior annular ligament. 4. Palmaris longus. 5. Palmar fascia. 6. Flexor carpi ulnaris. 7. Flexor digito-

The anterior surface of the pronator teres is superficial in the greater part of its extent; but towards its insertion it is crossed by the radial artery and nerve, and the supinator longus muscle. The ulnar border is in contact with the flexor carpi radialis and palmaris longus: the radial border bounds with the supinator longus an angular space, in which are placed the brachial artery, the median nerve, and the tendon of the biceps muscle. The pronator teres covers the flexor sublimis digitorum and ulnar artery; and the head which arises from the ulna pass between the last-named artery and the median nerve. Parts adjacent.

The origin of the pronator teres sometimes increases in extent, the additional fibres being derived from the inter-muscular partition above the inner condyle of the humerus. The added portion is usually continuous with the upper margin of the muscle; but in some instances it will be found separated at first from it by an interval. This peculiarity of the muscle is repeatedly found associated with a change in the direction of the brachial artery.* Increase in extent of origin.

The *flexor carpi radialis*,—Cowper, (radialis internus,—Alb.) (fig. 116,[2]) is situate in front of the fore-arm, extending from the inner condyle to the outer side of the metacarpus. Flexor carpi radialis.
It *arises* from the inner condyle by the common tendon, from the fascia of the arm, and from the inter-muscular septa placed between it and the pronator teres on one side, the palmaris longus on the other, and the flexor sublimis posteriorly. The fleshy fibres soon end in a fibrous expansion, which narrows into a flat tendon, and is free from the muscular part a little below the middle of the fore-arm. Arrived at the carpus, the tendon passes in a special compartment at the outer side of the anterior annular ligament of the wrist, and runs through a groove in the os trapezium (to which it is bound by a thin fibrous sheath, lined by a synovial membrane), to be *inserted* into the extremity of the second metacarpal bone: from its insertion a fasciculus passes to the third and sometimes the fourth bone. Attachments above and below.

The anterior surface is covered by the fascia and integument; the posterior rests on the flexor sublimis, the flexor pollicis longus, and the wrist-joint. Its tendon lies between those of the supinator radii longus and palmaris longus, and to its outer side lies the radial artery. Parts adjoining.

rum sublimis. 8. Supinator longus. 9, 10. Extensor carpi radialis longior and brevior. 11. Short muscles of the thumb. 12. Palmaris brevis. 13. Muscles of the little finger.

* "The Arteries," &c., page 260 and 264, and plates 36 and 37.

Palmaris longus.

The *palmaris longus* (fig. 116,[4]), the smallest of this mass of muscles, lies along the middle of the fore-arm, on the ulnar side of the preceding muscle. It *arises* from the inner condyle and the inter-muscular septa. The small fleshy belly of the upper part soon ends in a long slender tendon, which is continued into the palmar fascia,[5] and oftentimes a slip joins the short muscles of the thumb. This muscle is placed between the flexores carpi radialis and ulnaris, resting on the flexor sublimis.

The muscle may be absent; or double.

The palmaris longus is frequently altogether wanting. When present, it is subject to many variations of form, *e. g.* the muscular fibres may occupy the middle of the muscle, which then commences and ends by an elongated tendon; or the muscular structure may be placed towards the lower end, the upper part being tendinous. Occasionally there are two long palmar muscles, one having the ordinary shape, while the other has one of the forms above referred to. The most remarkable peculiarity is that in which a small muscle (a second palmaris longus, placed nearer to the inner border of the fore-arm than the usual muscle) covers the ulnar artery for some space above the carpus, and terminates partly in the annular ligament of the carpus or the fascia, and partly in the short muscles of the little finger. An account of some examples of peculiarities in this muscle have been given elsewhere.*

Flexor carpi ulnaris.

The *flexor carpi ulnaris*,—Cowper, (ulnaris internus,—Alb.,) (fig. 116,[6]) is superficial along the ulnar border of the fore-arm, being extended from the humerus to the inner margin of the wrist. It *arises* by two tendinous processes or heads; and the interval between these is occupied by fibrous tissue arching over the ulnar nerve. One of them is attached to the inner condyle of the humerus. The other is fixed to the inner side of the olecranon, joining with an inter-muscular septum; and to the posterior border of the ulna by a dense aponeurosis for three-fourths of the length of the bone. The muscular fibres from these points of attachment terminate in a tendon, which is *inserted* into the pisiform bone, offsets being prolonged to the base of the fifth metacarpal bone, the annular ligament, and the muscles of the little finger. The tendon is at first concealed within the muscle, but it afterwards appears on the outer side, and receives muscular fibres at the opposite aspect nearly to its termination. The union of the fleshy with the tendinous part resembles the junction between half of the feather with the shaft of a quill, and the arrangement is therefore called semi-penniform.

Origin—two parts, separated by ulnar nerve.

* "The Arteries," &c., p. 334, and plate 45.

The anterior surface is covered by the skin and fascia; the posterior rests on the flexor profundus, and overlaps the ulnar nerve and artery. Towards the lower part of the fore-arm the artery is nearly opposite the outer margin of the muscle, so that this may be taken by surgeons as a guide to the position of the vessel.

Is guide to ulnar artery.

The *flexor digitorum sublimis vel perforatus* (perforatus,—Cowper; sublimis,—Alb.)—The superficial flexor of the fingers (fig. 116,[7]) is placed at the anterior part of the fore-arm, between the preceding muscles which conceal it, and the flexor profundus and flexor longus pollicis which are beneath it. It is flat and broad in the upper part, and divided inferiorly into four tendons. It *arises* from the inner condyle by the common tendon, and the fibrous septa common to it and the other muscles; from the internal lateral ligament; from the anterior surface of the coronoid process at the inner side; and from the oblique line extended downwards from the tubercle of the radius below the insertion of the pronator teres. The fleshy belly enlarges towards the middle of the arm, but diminishes somewhat before its division. The four tendons pass under the annular ligament of the wrist in pairs, which are placed in front of each other; the anterior pair consists of the tendons for the middle and ring fingers, the posterior of those for the index and the little finger.

Flexor digitorum sublimis is between superficial and deep muscles.

Origin.

Four tendons,

As they proceed to their destinations the tendons diverge, (the largest belonging to the middle finger, the smallest to the little finger,) and each, accompanied by a tendon from the flexor profundus, enters beneath fibrous bands (ligamenta vaginalia), (fig. 117, A,) which are firmly fixed to the margins of the phalanges, and bind both tendons together down to the palmar surface of the bones;—constructing thus a fibro-osseous canal for the tendons. Opposite the first phalanx the tendon of the flexor sublimis presents a fissure, (fig. 117, B,) which transmits that of the deep flexor (whence the name perforatus); and finally, after expanding somewhat and forming on its palmar surface a groove, which is adapted to the accompanying tendon, it is *inserted* by two slips into the margins of the second phalanx about the centre. The same arrangement obtains in each instance within the canals on the fingers. A few slender and loose bands are extended from the phalanges to both the tendons: they have been named "vincula accessoria tendinum," or "vincula vasculosa." Underneath each tendon, near its insertion, is

accompany tendons of flexor profundus.

Both in canals on fingers.

Tendon perforated.

Insertion.

Vincula vasculosa.

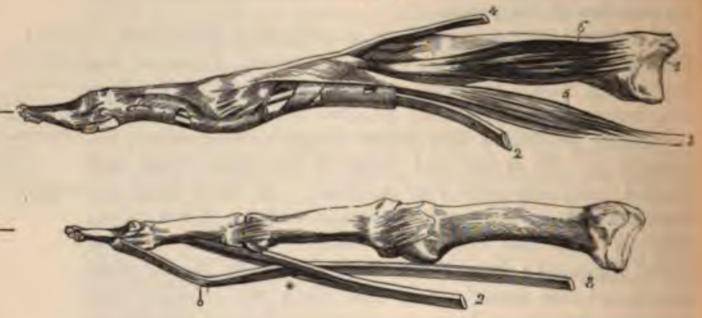
Ligam. brevia.

a short membranous structure (ligam. breve), which fixes the tendon to the front of that phalanx behind the one into which it is inserted.*

Fig. 117.†

A.—

B.—



Parts over and under.

Superiorly, the flexor sublimis is concealed by the other muscles of the superficial set, and is crossed near the radius by the radial artery; it rests on the flexor pollicis longus and flexor profundus, separated from the latter by the median nerve and the ulnar artery. In the palm of the hand, its tendons are covered by the palmar fascia, the superficial palmar arch of arteries, and the branches of the median nerve; and they lie in front of the accompanying tendons of the flexor profundus, except after they have been perforated by these. Where the tendons slide beneath the annular ligament, they are invested by a synovial membrane; and a similar provision for easy movement exists on the phalanges of each of the fingers.

Synovial sac under annular ligament and on each finger.

* In the last of these ligaments Mr. Marshall recognises the existence of fine bands of elastic tissue. He assigns to it the use of straightening the longest tendon after this has been bent in flexing the fingers. "On certain Elastic Structures connected with the deep Flexor Tendons of the Fingers and Toes," by John Marshall, F.R.C.S.E. See British and Foreign Med. Chir. Review, Jan. 1853.

† The metacarpal and phalangal bones of two fingers, with the tendons. In the first figure the tendons of the flexor muscles are bound to the finger by the fibrous bands, in the second they are freed from that structure, as well as from the synovial membrane and the vincula accessoria. 1. Metacarpal bone. 2. Tendon of flexor sublimis. 3. Tendon of flexor profundus. * The perforation of the former by the latter. 4. Tendon of extensor digitorum communis. 5. A lumbricalis muscle. 6. An inter-osseous muscle.

This muscle is subject to several slight variations from the arrangement above described. One or two may be referred to :—A muscular slip is frequently given from it to the flexor profundus, or to the flexor longus pollicis. The tendon for the little finger is sometimes wanting, and this deficiency is occasionally found in the corresponding tendon of the superficial flexor of the toes.

Deep muscles.

The *deep-seated* muscles, on the anterior surface of the fore-arm, are the flexor profundus, flexor pollicis longus, and pronator quadratus.

Dissection of the deep layer.

Dissection.—When the superficial muscles have been examined, consisting of the pronator teres, flexor radialis, palmaris longus, flexor ulnaris, and flexor sublimis, their common origin may be divided, and the whole mass drawn down towards the hand ; which will expose the flexor profundus and flexor pollicis longus, as well as the median nerve and ulnar artery. The inter-osseous nerve and artery will at once be found between the two muscles last mentioned.

Fig. 118.*

Flexor profundus.

Flexor digitorum profundus vel perforans (perforans,—Cowper ; profundus,—Alb.).—The deep flexor of the fingers (fig. 118,[1]) lies towards the ulnar side of the fore arm, covered by the preceding muscles. It is thin and compressed above, presents in the middle a fleshy belly of considerable size, and inferiorly is divided into four tendons.

Origin.

The muscle *arises* from the hollow at the inner side of the olecranon ; from the inner and anterior surfaces of the ulna for three-fourths of the length of the bone ; from the ulnar half of the inter-osseous ligament for the same distance ; and from the aponeurosis attaching the flexor carpi ulnaris to the ulna.

Four tendons.

The tendons are free from the muscular substance above the wrist, and that destined for the index finger is the only one that is distinct from the others,—the rest being

* The deep muscles of the anterior surface of the fore arm. 1. Flexor profundus digitorum. 2. Flexor longus pollicis. 3. Pronator quadratus. 4. Adductor pollicis. 5. Inter-osseous muscles.

connected together as far as the palm. Under the annular ligament, they lie behind the tendons of the flexor sublimis, and they maintain the same relation to these latter as they pass along the metacarpal bones and the first phalanges. Opposite the first phalanx, the tendon of each finger passes through the fissure formed for its transmission in the tendon of the flexor sublimis (fig. 117, B), and is *inserted* into the base of the last phalanx. The tendons are bound to the phalanges by fibrous bands, and are connected with those bones by the vincula accessoria in the manner mentioned in describing the last muscle.

They perforate those of flexor sublimis.

Parts adjacent.

Embraces brachialis anticus.

The upper extremity of the muscle in a manner embraces the insertion of the brachialis anticus. The posterior surface rests on the ulna, the interosseous ligament, and the pronator quadratus; the anterior one is covered by the ulnar artery and nerve, the median nerve, and the other flexor muscles. The external border is parallel with the flexor pollicis longus, from which it is separated, on the interosseous membrane, by the anterior interosseous vessels and nerve. The tendons are covered by the synovial sacs, which have been mentioned as in connection with the flexor sublimis.

Supports ulnar artery.

Synovial sacs.

Lumbricals, four:

The *lumbricales* (fig. 121,[16]) are four tapering, fleshy fasciculi, extended from the tendons of the flexor profundus to the first digital phalanges, and are therefore to be considered accessories or appendages to that muscle. They arise by fleshy fibres from the outer or radial border of the deep flexor tendons, and proceed forwards to the corresponding sides of the fingers, where they are inserted into the tendinous expansion covering the dorsal aspect of the metacarpal phalanx of the fingers. They are covered by the palmar fascia, and partly by the tendons of the flexor sublimis. The outer two have a single, and the others a double origin.

from tendons of flexor profundus to extensor communis.

They vary.

These little muscles are subject to many deviations from the ordinary arrangement. The number is not unfrequently diminished to three, or it may be increased (much more rarely, however) to five or six. The destination of one or two of them is often changed, and one finger (most frequently the third or fourth) may be provided with two. Lastly, one may be divided between two fingers.

Flexor longus pollicis.

Flexor longus pollicis manus (fig. 118,[2]).—The long flexor of the thumb lies on the same plane as the flexor profundus, resting on the radius. It *arises* from the grooved surface on

Origin.

the fore part of the radius,—commencing just below the oblique line which extends downwards from the tubercle, and reaching to the edge of the pronator quadratus,—from the inner part of the coronoid process by a rounded fleshy and tendinous slip, also from the adjacent part of the interosseous ligament. The fleshy fibres come forward to a tendon which, after passing beneath the annular ligament of the wrist, turns outwards, lying between the two heads of the flexor brevis and the sesamoid bones, and then enters a canal similar to that for each of the other flexor tendons. Finally the tendon is *inserted* into the base of the second phalanx of the thumb. Insertion.

This muscle is covered by the flexor carpi radialis, flexor sublimis, and somewhat by the radial vessels inferiorly. The inner border is in contact with the flexor profundus, the anterior interosseous artery and nerve being interposed. Towards the lower part of the arm its fibres can be perceived between the tendons of the supinator longus and flexor carpi radialis. Parts adjacent. Radial artery in front; inter-osseous artery inside.

Pronator quadratus (fig. 118,[3]; fig. 122,[1]).—This small square muscle is placed beneath the other muscles, and is extended across the radius and ulna, immediately above their carpal extremities; it is flat and thick (especially so at the middle), and about two inches in breadth. Its origin, or fixed attachment, comes from the anterior and inner surfaces of the ulna (curving over the bone), in the situation and for the extent just mentioned, and from a tendinous layer on the surface. The fibres pass directly across, and are inserted into the fore part of the radius for about two inches. Pronator quadratus, deep position; curves over part of ulna.

One surface of the muscle rests on the bones and interosseous membrane, and covers the anterior interosseous artery and nerve; the other is in contact with the tendons of the flexor muscles, and the radial artery. Parts adjacent. Interosseous and radial artery.

Combined Actions.—These muscles act on the fore arm, the hand, and the digital phalanges. The radius is made to turn on the ulna, and the hand thereby pronated by the *pronator teres* and *quadratus*, which take their fixed points, the one on the humerus, the other on the ulna, and draw the radius inwards across the latter bone. Should the pronator teres, after having effected so much, continue its action, it becomes virtually a flexor, and will assist the other muscles in bending the fore arm on the arm.—So also the *flexors of the fingers*, after having bent the phalanges Action on radius, on wrist,

connected together as far as the palm. Under the annular ligament, they lie behind the tendons of the flexor sublimis, and they maintain the same relation to these latter as they pass along the metacarpal bones and the first phalanges. Opposite the first phalanx, the tendon of each finger passes through the fissure formed for its transmission in the tendon of the flexor sublimis (fig. 117, B), and is *inserted* into the base of the last phalanx. The tendons are bound to the phalanges by fibrous bands, and are connected with those bones by the vincula accessoria in the manner mentioned in describing the last muscle.

They perforate those of flexor sublimis.

Parts adjacent.

Embraces brachialis anticus.

The upper extremity of the muscle in a manner embraces the insertion of the brachialis anticus. The posterior surface rests on the ulna, the interosseous ligament, and the pronator quadratus; the anterior one is covered by the ulnar artery and nerve, the median nerve, and the other flexor muscles. The external border is parallel with the flexor pollicis longus, from which it is separated, on the interosseous membrane, by the anterior interosseous vessels and nerve. The tendons are covered by the synovial sacs, which have been mentioned as in connection with the flexor sublimis.

Supports ulnar artery.

Synovial sacs.

Lumbricals, four:

from tendons of flexor profundus to extensor communis.

The *lumbricales* (fig. 121,[16]) are four tapering, fleshy fasciculi, extended from the tendons of the flexor profundus to the first digital phalanges, and are therefore to be considered accessories or appendages to that muscle. They arise by fleshy fibres from the outer or radial border of the deep flexor tendons, and proceed forwards to the corresponding sides of the fingers, where they are inserted into the tendinous expansion covering the dorsal aspect of the metacarpal phalanx of the fingers. They are covered by the palmar fascia, and partly by the tendons of the flexor sublimis. The outer two have a single, and the others a double origin.

They vary.

These little muscles are subject to many deviations from the ordinary arrangement. The number is not unfrequently diminished to three, or it may be increased (much more rarely, however) to five or six. The destination of one or two of them is often changed, and one finger (most frequently the third or fourth) may be provided with two. Lastly, one may be divided between two fingers.

Flexor longus pollicis.

Origin.

Flexor longus pollicis manus (fig. 118,[2]).—The long flexor of the thumb lies on the same plane as the flexor profundus, resting on the radius. It *arises* from the grooved surface on

the fore part of the radius,—commencing just below the oblique line which extends downwards from the tubercle, and reaching to the edge of the pronator quadratus,—from the inner part of the coronoid process by a rounded fleshy and tendinous slip, also from the adjacent part of the interosseous ligament. The fleshy fibres come forward to a tendon which, after passing beneath the annular ligament of the wrist, turns outwards, lying between the two heads of the flexor brevis and the sesamoid bones, and then enters a canal similar to that for each of the other flexor tendons. Finally the tendon is *inserted* into the base of the second phalanx of the thumb. Insertion.

This muscle is covered by the flexor carpi radialis, flexor sublimis, and somewhat by the radial vessels inferiorly. The inner border is in contact with the flexor profundus, the anterior interosseous artery and nerve being interposed. Towards the lower part of the arm its fibres can be perceived between the tendons of the supinator longus and flexor carpi radialis. Parts adjacent. Radial artery in front; inter-osseous artery inside.

Pronator quadratus (fig. 118,[3]; fig. 122,[1]).—This small square muscle is placed beneath the other muscles, and is extended across the radius and ulna, immediately above their carpal extremities; it is flat and thick (especially so at the middle), and about two inches in breadth. Its origin, or fixed attachment, comes from the anterior and inner surfaces of the ulna (curving over the bone), in the situation and for the extent just mentioned, and from a tendinous layer on the surface. The fibres pass directly across, and are inserted into the fore part of the radius for about two inches. Pronator quadratus, deep position; curves over part of ulna.

One surface of the muscle rests on the bones and interosseous membrane, and covers the anterior interosseous artery and nerve; the other is in contact with the tendons of the flexor muscles, and the radial artery. Parts adjacent. Interosseous and radial artery.

Combined Actions.—These muscles act on the fore arm, the hand, and the digital phalanges. The radius is made to turn on the ulna, and the hand thereby pronated by the *pronator teres* and *quadratus*, which take their fixed points, the one on the humerus, the other on the ulna, and draw the radius inwards across the latter bone. Should the pronator teres, after having effected so much, continue its action, it becomes virtually a flexor, and will assist the other muscles in bending the fore arm on the arm.—So also the *flexors of the fingers*, after having bent the phalanges Action on radius, on wrist,

towards the palm, begin to act on the wrist, and then contribute to the flexion of the fore arm by drawing on the annular ligament of the wrist under which they pass.—The *flexores carpi*, too, after having bent the wrist, become subsequently flexors of the fore arm. The flexion of the phalanges is obviously effected by the superficial and deep common flexors and by the flexor pollicis.

on fingers.

RADIAL REGION.

The muscles placed along the outer side of the fore arm are the supinator radii longus and brevis, the extensor carpi radialis longior and brevior.

Fig. 119.*

Dissection.

Dissection.—These muscles are readily exposed by reflecting the skin and the fascia outwards, from a few inches above the external condyle down to the wrist; the preceding dissections obviously mark out the way of conducting this.

Supinator longus;

Supinator longus, — Douglas and Alb. (supinator radii longus,—Cowper; brachio-radialis, — Sœmmerring) (fig. 116,[8]; fig. 119,[1]).—This is the first and most prominent muscle of the external set, and lies upon the radial border of the arm, extending from nearly the middle of the humerus to the end of the radius. It *arises* from the upper two-thirds of the external condyloid ridge of the humerus, and is interposed between the brachialis anticus, and the external intermuscular septum to which its fibres are attached. The thin fleshy mass proceeding from this elongated source descends upon the anterior and outer border of the arm; and ends in a flat tendon about the middle, which, continuing the same

its length.

Origin.

* The superficial muscles of the posterior surface of the fore-arm. 1. Supinator longus. 2, 3. Extensor carpi radialis, longior and brevior. 4. Anconeus. 5. Extensor communis digitorum. 6. Extensor proprius minimi digiti. 7. Extensor carpi ulnaris. 8. The extensor muscles of the thumb.

course, is *inserted* into the external border of the radius, near the base of the styloid process. Insertion.

Parts adjacent. Is subcutaneous.

This muscle is covered only by the skin and fascia, except the insertion, which is covered by two extensor muscles of the thumb. It rests on the humerus, the extensores carpi radialis (longior and brevior), the radial nerve, and the radius. The inner border is in contact, above the bend of the elbow, with the brachialis anticus, and with the musculo-spiral nerve and the accompanying artery; along the fore-arm it is contiguous to the radial artery, and serves as a guide to the position of the vessel. Guide to radial artery.

Extensor carpi radialis longior.

The *extensor carpi radialis longior* (radialis externus longior,—Alb.) (fig. 116,[9]; fig. 119,[2]) is partly covered by the preceding muscle, but its external border projects beyond it. It *arises* lower down than the supinator longus from the lower third of the external condyloid ridge, as well as from the intermuscular septum. Origin. After passing along the outside of the elbow, it ends, at the upper third of the fore-arm, in rather a broad, flat tendon which, descending along the outer and back part of the radius, passes conjointly with that of the following muscle in a groove in the lower extremity of that bone, and is inserted into the base of the metacarpal bone of the fore-finger. Tendon in groove of radius. The fleshy portion of the muscle is partly covered by the supinator longus, and the upper fibres are often continuous with the lower part of that muscle. Its tendon passes beneath the extensors of the thumb, and the posterior annular ligament of the wrist; and underneath its insertion is a small bursa.

Extensor carpi radialis brevior.

Extensor carpi radialis brevior,—Douglas (radialis externus brev.,—Alb.) (fig. 116,[10]; fig. 119,[3]).—Shorter, as the name implies than the preceding, to which it immediately succeeds on the fore-arm, this muscle *arises* from the extremity of the outer condyle of the humerus, by a common tendon and fibrous processes which intervene between it and other extensor muscles, also from a tendinous expansion on its surface, and from the external lateral ligament of the elbow-joint. Origin. The fleshy belly ends in a flat tendon, which remains closely applied to that of the preceding muscle, and with it proceeds in the groove in the radius, and under the annular ligament; on the wrist it diverges somewhat to be *inserted* into the base of the metacarpal bone of the middle finger. Tendon with that of former in groove of radius. Insertion. Covered by the two preceding muscles, it rests on the radius, the supinator brevis, and the pronator teres. Between it and the supinator is one bursa;

and between its tendon and the metacarpal bone is a second smaller one.

Action of the supinators, and radial extensors.

Combined Actions.—These are the direct antagonists of the pronators of the hand and flexors of the wrist. If the hand be previously pronated, the supinators, by rolling the radius on the ulna, turn the palm supine; but the extent and power of action of each differ considerably. The *supinator longus*, notwithstanding its length and size, can act but feebly in supinating the hand, inasmuch as its direction is parallel with that of the radius; its direction and attachments indicate it to be a flexor of the fore arm. The *supinator brevis* (page 106), both by its direction and mode of attachment, is by far the more efficient agent in moving the radius on the ulna. The action of the *radial extensors* is fully indicated by their name; if their effort be continued, they assist in extending the fore arm on the arm.

BRACHIAL REGION (POSTERIOR AND SUPERFICIAL).

Posterior muscles, two sets.

The muscles on the posterior aspect of the fore arm are divisible into superficial and deep; in the former set are the anconeus, the extensor communis digitorum, extensor carpi ulnaris, and extensor minimi digiti; whilst in the latter are the three extensors of the thumb, the extensor indicis, and the supinator radii brevis.

Dissection of back of fore arm.

Dissection.—The muscles on the posterior side of the fore arm are so numerous and closely connected together, as to render their dissection and arrangement somewhat difficult. An incision may, in the first place, be made from the olecranon to the middle of the back of the hand, which should be bounded at each extremity by a transverse incision. The skin, having been thus divided, may be reflected off the fascia in its entire extent; and, when the fascia has been examined, it may be divided in the same way as the skin, and dissected off the muscles; this process will be facilitated by proceeding from below upwards, and taking the different tendons as guides to their respective muscles, until all of them are exposed, and their borders defined. When this has been effected, little difficulty will be experienced in distinguishing them from one another, if the first line of the description given of them be attended to, as it indicates the situation and direction of each; and, when the name of a muscle is known, everything relative to its anatomical characters will be found in the section which treats of it.

Anconeus, triangular.

Ths *anconeus* (fig. 119,[4]; ἀγκὼν, the elbow) is placed immediately behind and beneath the elbow-joint, being a small triangular muscle. It *arises*, by a tendon, from the

extremity of the outer condyle of the humerus, at the posterior aspect. From this the fibres proceed, diverging from one another, the upper ones being horizontal, the rest passing downwards with increasing degrees of obliquity; and all are *inserted* into the olecranon at the radial aspect, and into the adjacent impression on the upper third of the ulna itself. Insertion;

The anconeus is superficial in its entire extent, and lies below the outer part of the triceps extensor, with which it is continuous by its upper margin. It covers part of the ligament of the elbow-joint, together with the supinator brevis and the recurrent branch of the interosseous artery. connected with triceps; covers joint.

The *extensor communis digitorum* (fig. 119,[5]) lies along the posterior part of the fore arm. It *arises* by a tendon common to it and the remaining superficial extensor muscles, also from the fascia of the arm, and the septa between it and the adjoining muscles. Somewhat below the middle of the fore arm the muscular part ends in four tendons, which pass beneath the posterior annular ligament of the wrist, and diverge as they proceed along the carpus and metacarpus to reach the fingers. Here each is increased by tendinous fibres derived from the lumbricales and interosseous muscles, forming a fibrous expansion (see fig. 117), which covers the back of the first and second digital phalanges, and terminates upon the third. It is attached to the second and third phalanges in the following manner:—Opposite the first bone the tendon divides into three fasciculi; the central one is much thinner than the others, and is inserted into the base of the second phalanx; the two lateral parts, continuing onwards, are joined together towards the middle or fore part of the second phalanx, and, having passed beyond this, are inserted into the last phalanx. On the index and little fingers the tendons are joined before their division, by the special extensor tendons of those digits. Moreover, the tendon furnished from the common extensor to the fore-finger is separate from the rest; while the others are connected by transverse bands over the metacarpus. Extensor communis. Tendons joined by lumbricales and interossei. Tendinous expansion divides into three; middle part to second phalanx, two lateral parts to last phalanx. Tendons joined by special extensors.

At its origin, this muscle lies between the extensor carpi radialis brevior and the extensor minimi digiti, and maintains the same relation as it descends towards the wrist. It covers the supinator radii brevis, the extensors of the thumb at their origin, and the indicator. A synovial membrane encases the tendons as they pass under the annular ligament. Parts adjacent. Synovial sac.

Extensor digiti minimi is joined to extensor communis.

Extensor minimi digiti (extensor proprius auricularis,—Alb.) (fig. 119,[6]).—The extensor of the little finger is usually united with the common extensor. It is placed between that muscle and the extensor carpi ulnaris; and *arises*, in common with the extensor communis, by a thin tendinous part giving origin to a slender bundle of fleshy fibres. The tendon in which it ends passes through a ring in the annular ligament appropriated to itself, and joins with the fourth digital tendon of the common extensor, conjointly with which it expands upon the posterior surface of the phalanges of the little finger.

Has separate ring of annular ligament. Tendon joins that of extensor communis.

Extensor carpi ulnaris;

Extensor carpi ulnaris (ulnaris externus,—Alb.) (fig. 115,[7]) lies towards the ulnar border of the fore arm, being extended from the external condyle to the root of the little finger. It *arises* from the external condyle of the humerus by the common tendon and an elongation from it; from the posterior border of the ulna, below the anconeus, for about the middle third; and from the fascia of the fore arm. The muscular fibres derived from this source incline somewhat inwards, and end in a tendon, which runs through a special groove in the carpal end of the ulna and a separate sheath in the annular ligament, and is inserted into the posterior extremity of the metacarpal bone sustaining the little finger.—Like the foregoing muscles, it is covered only by the skin and fascia, and it conceals the supinator brevis in part, as well as the extensor of the index finger.

passes in groove of ulna.

Parts over and under.

BRACHIAL REGION (DEEP POSTERIOR).

The deep-seated muscles on the back of the fore arm are all less in size and length than the superficial set, and they are readily distinguishable by the obliquity of their direction.

Dissection of the deep muscles.

Dissection.—When the long extensors arising from the external condyle have been examined, they may be detached from their origin, and drawn outwards, so as to expose those which lie deeply between, or on the bones. The supinator brevis and anconeus, both short muscles, and oblique in the direction of their fibres, will be seen close below the elbow-joint; whilst the extensors of the thumb, and the indicator, lie obliquely over the middle and lower parts of the bones.

Extensor metacarpi pollicis is largest of deep series.

Extensor ossis metacarpi pollicis (fig. 120,[2]) (abductor longus pollicis manus,—Alb.).—This muscle, the extensor of the metacarpal bone of the thumb, which is the largest of the

deep extensor muscles, descends obliquely over the bones of the fore arm from the posterior to the outer side, lying immediately below the border of the supinator brevis. It *arises* from the upper half in length of the external border of the ulna, from the posterior surface of the radius below the supinator brevis for three inches, and from the interosseous ligament. Its fleshy belly ends in a tendon, which passes through a groove in the outer border of the radius, common to it and the extensor of the first phalanx of the thumb, and is *inserted* into the base of the metacarpal bone of the thumb.

Tendon with that of next, in groove of radius.

Fig. 120.*

The origin and upper part of the muscle are concealed by the common extensor, but it becomes superficial where it lies on the external border of the radius.

Is oblique, and partly superficial.

Extensor primi internodii pollicis (extensor minor pollicis manus,—Alb.).—The extensor of the first phalanx (fig. 120,[3]) is much smaller than the preceding, and lies close to its lower border. The muscle *arises* from the interosseous ligament and the radius by a fleshy part about one inch in width; it takes the same direction as the abductor, which it accompanies through the same compartment of the annular ligament, and over the corresponding border of the carpus. The tendon proceeds onwards to the thumb and is *inserted* into the upper end of the first phalanx.

Extensor primi internodii pollicis is small.

Accompanies preceding muscle.

Extensor secundi internodii pollicis (extensor major pollicis manus,—Alb.).—The extensor of the second phalanx (fig. 120,[4]) is much larger than the preceding muscle, which it partly covers; its direction is obliquely downwards and forwards from the ulna to the thumb. It *arises* from the

Extensor secundi internodii pollicis.

* The deep-seated muscles of the back of the fore arm, with the dorsal interosseous of the hand. 1. Supinator brevis. 2. Extensor ossis metacarpi. 3. Extensor primi internodii, and 4. Extensor secundi internodii pollicis. 5. Extensor indicis. 6, 9. Dorsal interosseous muscles.

back part of the ulna, immediately below the great abductor, for about the lower half of the shaft and from about an inch of the interosseous ligament below. The fleshy belly derived from these attachments soon ends in a tendon, which is bound down in a separate compartment of the annular ligament, and runs through the narrow oblique groove (specially appropriated to it) at the middle of the carpal end of the radius; it is *inserted* into the base of the second phalanx of the thumb.

Has separate groove on radius.

Connection with other tendons.

Whilst passing along its bony groove, the tendon of this muscle is separated from those of the other extensors of the thumb, by the groove which lodges the radial extensors; and near the base of the first metacarpal bone, the radial artery lies in the interval which separates them.

A part of the tendon of the extensor ossis metacarpi is often found to terminate in the upper end of the abductor pollicis.—The extensor primi internodii is not unfrequently united with the extensor of the metacarpal bone, and only a slender tendinous filament reaches the first phalanx.—A portion of the third muscle (extensor secundi internodii) has been found attached to the first phalanx.

Extensor indicis

Extensor indicis (fig. 120,[5]) (indicator).—The extensor of the index finger is nearly of the same size as the preceding muscle, along whose lower border it lies. It *arises* from the posterior surface of the ulna for three or four inches, and usually below the middle. The tendon, which is continued from the muscular part, passes with the common extensor beneath the annular ligament, comes in contact with the digital tendon of the latter, destined for the index finger, and unites with it to form the tendinous expansion; and together they are *inserted* into the posterior surface of the second and third phalanges, in the manner mentioned in the description of the common extensor muscle.

with common extensor in annular ligament. On finger joins common extensor.

Supinator brevis curves over upper end of radius.

The *supinator brevis* (supinator radii brevis,—Cowper) (fig. 120,[1]) is a short triangular muscle, lying in close contact with the bones, and extended obliquely over the upper third of the radius. It *arises* from the external lateral ligament of the elbow-joint, and from the annular ligament of the radius; also from a rough depression below the sigmoid cavity of the ulna, and from the outer border of the bone for two inches. The fibres of the muscle, derived from these points of attachment, as well as from a tendinous expansion on the surface, pass obliquely round the upper part of the radius, covering it except at the inner side, and

are *inserted* into rather more than a third of that bone, viz., as low as the insertion of the pronator teres. **Insertion.**

The supinator brevis is covered by the superficial set of muscles. It lies on the ligaments at the outer side of the elbow-joint; and the posterior interosseous nerve passes through its fibres. By means of a notch in the anterior margin, it is adapted to the bicipital tuberosity of the radius. **Covers elbow-joint.** **Is notched for biceps.**

Combined Actions.—These muscles act on the fingers and hand in the first instance, and then, by a continuance of their effort, on the fore arm which they assist in extending. The common extensor, as well as those of the thumb, the fore finger, and little finger, are, from their situation and attachments, the direct antagonists of the flexors; the latter, however, from their size and number are the more powerful agents. If the bones of the thumb be drawn inwards to the palm, as when an object is firmly grasped, their extensor muscles may, by reason of the obliquity of their direction, assist in supinating the hand. Their names indicate their more ordinary action. The anconeus assists the triceps in extending the fore arm. The supinator brevis turns the radius on its axis, so as to bring the hand into the supine position. **Fingers extended;** **then wrist;** **then fore arm.** **Hand supinated.**

MUSCLES OF THE HAND.

The muscles of the palmar surface of the hand admit of being divided into three sets or groups, viz., those of the thumb, those of the little finger, and thirdly, those placed in the middle of the palm. The extensors, which have been described in the foregoing pages, and the dorsal inter-ossei, are the only muscles on the back of the hand. **Muscles of palm of hand.** **Three sets.**

Dissection.—The first step in the dissection of the hand consists in exposing the palmar fascia in its entire extent. (See its description among the structures of the same class.) For this purpose a transverse incision may be made at the wrist, down to the annular ligament; for, as the fascia arises from it, it affords an easy guide to that membrane. The integument may then be raised, and reflected forwards to the fingers, or to either side. When the fascia has been examined, it may be detached from its connection with the annular ligament, and removed altogether; by which means the flexor tendons, the superficial arch of arteries, and the branches of the ulnar and median nerves, are brought into view. The digital prolongations of these different parts can, in the next place, be traced along the fingers by merely removing the integument. The short muscles of the thumb, and those of the little finger, may next engage attention. But it will **Dissection of the palmar muscles.**

not be necessary to add anything to what is stated in the description of the muscles, care being taken to indicate their situation and general characters, so that no mistake can occur. Deep in the palm of the hand are situate one set of inter-ossei muscles; these cannot be seen until the flexor tendons are all removed. The extensor tendons must be displaced, in order to expose fully the dorsal inter-ossei. Particular attention should be paid to the position of the superficial palmar arch of arteries, as well as to its digital branches.

EXTERNAL PALMAR REGION:—THENAR.*

MUSCLES OF THE THUMB.

Number. The fleshy mass which forms the ball of the thumb consists of four muscles, which are inserted into the first metacarpal bone and the appertaining first phalanx —one to the former and three to the latter.

Fig. 121.†

Abductor pollicis. The *abductor pollicis* (abductor brevis pollicis manûs, — Alb.) (fig. 121,[4]) is a flat narrow muscle placed immediately beneath the skin. is small, It *arises* from the annular ligament of the wrist,[3] and from the ridge of the os trapezium; and proceeds outwards and forwards, to be *inserted* by a short thin tendon into the base of the first phalanx of the thumb, at the radial border.—

* "Græci prominentiores partes palmarum appellant θέναρα, deducto vocabulo ἀπὸ του θείνειν (θένειν), à percutiendo. Alii non omnes prominentiores palmæ partes sic appellatas existimant, sed eas tantùm quæ pollici subiiciuntur," &c.—Riolanus, "Anthropol." l. 5, c. 20.

Riolanus himself, however, used the word to designate one of the muscles, and applied the name "antithenar" to another. Winslow adopted and extended that plan of naming the muscles.

† The muscles and tendons of the palm—a portion of the tendons of the superficial flexor has been cut away to show the deep flexor and

The muscle is superficial in its entire extent, and rests on the opponens pollicis. and superficial.

Opponens pollicis manûs (fig. 121,[5]; fig. 122,[7]).—The fleshy bundle thus named is triangular in shape and is placed beneath the preceding, but its borders project laterally, so as to be perceptible at each side of that muscle. The fibres *arise* from the annular ligament and from the os trapezium and its ridge; and thence proceeding outwards and forwards are *inserted* into the whole length of the metacarpal bone of the thumb at the radial border. One surface is covered by the abductor and the integument, the other rests on bones and ligaments.

Opponens pollicis.

Origin.

Insertion into metacarpal bone in whole length.

Flexor brevis pollicis manûs.—This is larger than either of the preceding muscles, beneath which it is placed. Its carpal extremity is divided into two processes or heads,[6 6] the interval between which transmits the tendon of the long flexor. One of these, which is anterior, and therefore superficial relatively to the other, *arises* from the outer two thirds of the annular ligament, and from the os magnum; the other is attached to the os trapezoides and os magnum, to the sheath of the flexor carpi radialis, and to the bases of the second and third metacarpal bones. The fleshy fibres from these points of origin soon unite to form a single mass, but this again resolves itself into two short bundles, which are *inserted* into the opposite borders of the base of the first phalanx of the thumb. In each of the tendons of insertion a sesamoid bone is placed, where it passes over the first joint of the thumb; and one of them is joined by the abductor, and the other by the adductor pollicis.

Flexor brevis pollicis.

Two parts separated by tendon of long flexor.

Insertion by two tendons.

Sesamoid bone in each.

Adductor pollicis manûs (fig. 121,[7]; fig. 122,[4]).—The adductor of the thumb is partly placed in the fold of skin between the thumb and the index finger, being extended from the metacarpal bone that sustains the middle finger, to the base of the first phalanx of the thumb. Its form is triangular, and the base is attached to the former bone, the apex to the latter. It *arises* from the anterior two-thirds of the palmar surface of the metacarpal bone of the middle finger; from this the fibres proceed outwards, converging to a short tendon, which is *inserted* into the base of the first

Adductor pollicis extends from midst of hand to first phalanx.

the lumbricales. 1. Tendon of flexor carpi radialis. 2. That of flexor carpi ulnaris ending at the pisiform bone. 3. Anterior annular ligament of the carpus. 4. Abductor pollicis. 5. Opponens. 6, 6. Flexor brevis; and 7. Adductor pollicis. 8. Abductor; and 9. Flexor brevis minimi digiti. 10. Lumbricales.

phalanx of the thumb, where its fibres are blended with the inner insertion of the short flexor (fig. 121,[3]). Near its origin this muscle is covered by the tendons of the flexor muscles; a portion of it is subcutaneous.

Action of muscles of thumb.

Combined Actions.—The names applied to the muscles of the thumb sufficiently indicate their actions and use; they are eight in all, and may be arranged as follows. In the first place, it should be recollected that there are three moveable osseous pieces in the thumb, so articulated as to admit of the four movements of extension, flexion, abduction, and adduction.

Extensors.

There are three extensors, one for each bone, viz., the extensor of the metacarpal bone, and those of the first and second phalanges; these are long muscles, placed on the dorsal aspect of the fore arm and hand.

Flexors.

Opposed in situation and action to these are the three flexors, lying on the palmar aspect of the thumb, viz. the opponens (which may be considered a flexor of the metacarpal bone), the flexor brevis, or flexor of the first phalanx, and flexor longus, which is the flexor of the second phalanx.

Abductor. Adductor.

There remain the abductor and adductor, which likewise are opposed to one another in situation and action; one being superficial and external, and therefore well calculated to draw the thumb away from the fingers, whilst the other is internal and deep-seated, and thereby enabled to approximate it to them. If these moving powers be made to act

Circumduction.

successively, circumduction is performed; or, in other words, the thumb moves so as to describe a cone, whose summit is at its carpal articulation, and base at the line traversed by its extremity.

INTERNAL PALMAR REGION :—HYPOTHENAR.

MUSCLES OF THE LITTLE FINGER.

The thick fleshy mass at the inner border of the hand also consists of four muscles. One of them is cutaneous, the others are special muscles of the little finger.

Palmaris brevis.

Palmaris brevis (fig. 126,[12]). — This is a very small "cutaneous" muscle. It forms a thin and square plane of pale

Origin from fascia; insertion into skin.

fibres placed immediately beneath the skin. It *arises* from the palmar fascia, from which its fibres proceed transversely inwards, and are *inserted* into the skin along the inner border of the palm of the hand. It is superficial to the muscles of the little finger and the ulnar artery and nerve;

but these parts are covered immediately, and separated from the palmaris brevis by a thin elongation of the palmar fascia.

Abductor minimi digiti manûs (fig. 121,[5]).—The abductor of the little finger runs along the ulnar border of the palm of the hand. *Arising* by tendinous fibres from the pisiform bone,[2] and the insertion of the flexor carpi ulnaris, the fleshy belly ends in a tendon, which is *inserted* into the base of the first phalanx of the little finger at the ulnar border. — The muscle rests on the "opponens" of the little finger, and is covered by the palmaris brevis and palmar fascia.

Abductor minimi digiti.

From pisiform bone to first phalanx.

The *flexor brevis minimi digiti* (fig. 121,[9]) is placed on the same plane as the abductor, lying to the outer side and joined with it at the insertion, so that in this situation both constitute but one muscle. But at their origin, where an interspace exists between them, they are separated by the deep palmar branch of the ulnar nerve, and the communicating branch of the companion artery. It *arises* from the front of the annular ligament, and from the tip of the hook-like process of the unciform bone, and is *inserted* into the base of the first phalanx of the little finger in connection with the preceding muscle. In some instances the flexor does not exist, in which cases the abductor is found larger than usual: from this circumstance, as well as from its position and direction, it may be inferred that the last-named muscle, in addition to its ordinary action of abduction, can become also a flexor.

Flexor brevis.

From unciform bone to first phalanx with former.

Fig. 122.*

* Chiefly the deep-seated muscles of the hand. 1. Pronator quadratus. 2. Opponens. 3. Flexor brevis; and 4. Adductor pollicis. 5. Opponens minimi digiti. 6. Unciform bone. 7, 8. Inter-osseous muscles.

Opponens minimi digiti.

Opponens minimi digiti (adductor ossis metacarpi digiti minimi,—Alb.) (fig. 122,[5]). — This muscle is somewhat triangular in its form, and placed under cover of the others. It arises from the annular ligament, and from the hooked process of the unciform bone[6]; from these points the fibres incline forwards and inwards, to be *inserted* into the ulnar border of the fifth metacarpal bone for the whole length.

From unciform to metacarpal bone.

MIDDLE PALMAR REGION.

The muscles placed in the centre of the hand, are the lumbricales and inter-ossei. The former have been already described with the flexor digitorum profundus.

Inter-ossei.

The *interosseous* muscles (inter-ossei) occupy the intervals between the metacarpal bones, and are named from that circumstance. They extend from the sides of those bones to the first row of phalanges (métacarpo-phalangiens latéraux,—Chausier), and are divided into two sets, viz., those which are visible at the dorsal aspect of the metacarpus, and those seen only in the palm.

Two series.

Fig. 123.*

Dorsal set four.

The *dorsal interosseous* muscles (inter-ossei externi v. bicipites) (fig. 120,[6 6 9]) are four in number, and occupy each one of the spaces between the metacarpal bones. They are named numerically, like the spaces, from without inwards (fig. 123, [1 2 3 4]). One of them is known as the abductor indicis, and is sometimes placed in another group of muscles, though in position and mode of attachment it is strictly an interosseous muscle. The general characters of these muscles are as follows:—They lie between the metacarpal bones and appear on the dorsal aspect of the hand, yet project into the palm, where they are shown in fig. 122,[7 7]. They arise from the contiguous sides of the

Common characters.

Arise by two parts.

* The dorsal interosseous muscles of the right hand, and their connection with the tendons of the long extensor muscles of the fingers, are here represented.

bones between which they are placed, but more extensively from the metacarpal bone supporting the finger to which each muscle belongs; and the fibres from these sources converge to a common tendon placed in the middle. The two parts or heads of this double origin are separated, at the upper extremity, by a narrow angular interval, in which a perforating arterial branch passes from the one surface of the hand to the other. Lastly, the tendon of insertion of each terminates partly at the side of the base of the first phalanx, and partly by joining with the tendon of the common extensor muscle on the dorsum of the finger (fig. 117).

Separated by artery.

Inserted into first phalanx and extensor tendons.

The *first* dorsal inter-osseous muscle (fig. 120,[9]) (abductor indicis) is larger than the others, and lies in the interval between the thumb and the index finger. It arises by two heads; of which one, external and larger, is attached to the ulnar border of the first metacarpal bone for the upper half; the other to the contiguous margin of the second for nearly the whole length, the angular interval between them serving to transmit the radial artery into the palm of the hand. Both soon unite and become inserted, by a thin tendon, on the outer side of the index finger, in the manner stated above. The *second* dorsal inter-osseous muscle lies in the second metacarpal space. It arises from both bones, and terminates on the middle finger at the outer side. The *third*, similarly placed in the third metacarpal space, is inserted likewise into the middle finger, but on the opposite side to the preceding. And the *fourth*, lying in the corresponding space, is inserted into the ulnar side of the ring finger.

First dorsal inter-osseous;

heads separated by radial artery;

ends on index finger.

Second and third on middle finger.

Fourth, on ring finger.

Thus:—the index finger is furnished with one of these muscles on the outer side; the ring finger, likewise with one, which is situate on the opposite (inner) side; and the middle finger has two muscles, one on each side. From their position the muscles are calculated to separate the fingers, and thus to increase the breadth of the hand. Or, according to the ingenious method of explaining their action, suggested by M. Cruveilhier, they move the fingers from an imaginary line passed longitudinally through the middle of the hand, *i. e.* the centre of the middle finger. (See the figure 123.) The dorsal muscles, then, are abductors of the fingers.

Their actions.

The *palmar inter-osseous* muscles (inter-ossei interni) lie rather on the palmar surface of the bones than between

Palmar inter-ossei.

them; and, as they are mixed up with the preceding set (fig. 122), these should be removed, in order to facilitate the examination of the palmar series. They are three in number, and are named on the same principle as the dorsal muscles (fig. 124,[1 2 3]). Each arises from one metacarpal bone—that supporting the finger for which it is destined,—and terminates like the dorsal muscles in a small tendon, which is inserted into the base of the first phalanx at the side, and likewise joins with the common extensor tendon.

Three;

arise from one bone.

Inserted as dorsal set.

Fig. 124.*

Attachments.

The *first* palmar inter-osseous[1] muscle arises from the second metacarpal bone on the ulnar side, and is inserted at the same side of the index finger. The *second*[2] arises from the radial side of the fourth metacarpal bone, and is inserted on the same side of the ring finger. The *third*[3] arises from the radial side of the fifth metacarpal bone, and is inserted into the little finger.

Palmar inter-ossei are adductors.

The palmar inter-osseous are opponents of the dorsal muscles. Each moves the finger towards the middle of the hand; they are, therefore, adductors of the fingers.

Action on the fingers.

Actions.—Besides the influence they exert in separating the fingers and bringing them together, the inter-osseous muscles may, to a certain extent, assist the extensor communis in extending or drawing back the fingers; and also, if the fingers be but slightly bent,—the direction of the inter-ossei in this position forming an angle with that of the phalanges,—they may assist in drawing them to the palm of the hand, that is, in flexing them.

ABDOMINAL REGION.

Structure of abdominal wall.

The abdomen is surrounded, except in the situation of

* The palmar inter-osseous muscles are shown in connection with the bones of the right hand.

the spine, by muscular and fibrous structures, which are called its "walls" or "parietes." The fibrous structures are the membranes or aponeuroses in which the lateral muscles end.

At sides only muscles.

At each side the abdominal wall is formed of muscular substance only, and consists of three muscular strata, the fibres of which are disposed in different directions. Viewing them as extending from behind towards the anterior part of the body, the fibres of the first stratum or muscle are directed obliquely downwards; those of the second, obliquely upwards; of the third, transversely. And they are named accordingly,—"descending oblique," "ascending oblique," and "transverse." The first two are also distinguished as "external" and "internal," on account of the position they hold with respect to each other.

In front, membrane and muscle.

In front the abdomen is bounded by aponeurotic as well as muscular structure. The former, being continued from the lateral muscles, is in layers, between which is placed a pair of muscles, close to the middle line on each side. The fleshy fibres of the muscles found in this situation have a nearly vertical or straight course; one is named from this circumstance "rectus," the other, from its shape, "pyramidalis."

Posterior, thickest part.

The posterior is much the thickest part of the abdominal parietes, for here the vertebræ and the large muscles of the back enter into its composition. Exclusive of these, and anteriorly to them, a thin fibrous membrane extends from the "transverse" muscle to the vertebræ, incasing a single muscle, as in front. This muscle reaches between the hip-bone and the last rib, and is square; it is named, "quadratus lumborum." And the membrane is called the "lumbar fascia."

Different extent of abdominal wall in front and at sides.

The structures above briefly noticed as constituting the wall of the abdomen extend on each side from the middle line in front to the vertebral column, and occupy the interval between the ribs and sternum on the one hand, and the pelvis on the other. As their extent depends in a great measure on the interval to be filled up, a glance at the skeleton will show the length the muscles and membranes must have in different positions, and will make it evident that on the fore part of the abdomen they must have considerably greater length than on the posterior or lateral aspect. To the above general statement concerning the length of these structures the external oblique muscle affords

an exception, inasmuch as it reaches for some space above the margin of the ribs, and in so far forms a portion of the walls of the thorax.

The parts just reviewed in their combination will now be examined singly.

Dissection of the outer muscle.

Dissection.—To expose the external oblique muscle:—When commencing the dissection of the abdominal muscles, an incision may be made through the skin from the ensiform cartilage to the umbilicus, and another thence to the most depending part of the margin of the thorax. The angular flap of skin, bounded by these lines, may be easily reflected by commencing at its point, and taking the tendinous fibres of the external oblique muscle as a guide, each stroke of the scalpel being directed obliquely upwards and outwards. The flap should be reflected until its base, or attached border, is brought on a line with the ensiform cartilage, or somewhat higher, which is necessary in order to expose the digitated processes of the muscle and their intermixture with those of the serratus magnus. An incision may, in the next place, be carried horizontally inwards from the anterior superior iliac spinous process to the linea alba, and be there met by another drawn down from the umbilicus. The enclosed flap of skin should be reflected back to the posterior part of the lumbar region. If it be required to exhibit the muscle in its entire extent, the portion of integument still remaining on the lower part of the abdomen may be divided by an incision drawn from the pubes upwards, and the flap reflected down over Poupart's ligament. For the present, however, the integument, muscle, &c., in the iliac region will be left untouched, as they will require to be examined attentively when treating of the dissection of the parts connected with hernia.

External oblique; largest of lateral muscles.

The *external oblique* muscle of the abdomen, (fig. 109,[9]) (obliquus externus abdominis ; obliquus descendens ; costo-abdominalis ; ilio-pubi-costo-abdominalis,) the largest of the three side muscles, is situate on the lateral and anterior aspects of the abdomen, and consists of two parts ; one, muscular, occupies the side of the abdomen ; the other, aponeurotic, extends over the front of that cavity.

Origin.

Broad, thin, and irregularly quadrilateral in form, this muscle *arises* from the anterior surface of the eight inferior ribs, by fibres arranged in so many angular processes named digitations. These are placed between similarly formed parts (digitations) of the serratus magnus and latissimus dorsi (five in connection with the former, and three with the latter), in the manner the fingers of one hand may be interposed between those of the other ; and it is from this circumstance that the processes are named. The lower and the upper digitations of the muscle are connected with the ribs near their cartilages, but those in the middle are attached at some distance from these ; the lowest embraces

Inter-digitates with serratus and latissimus dorsi.

the point of the twelfth rib. The fleshy fibres from the last ribs pass down in nearly a vertical direction to be *inserted* into the external margin of the iliac crest of the hip bone for about the anterior half of its length ; all the rest incline downwards and forwards, and terminate in tendinous fibres, which form a broad aponeurosis[13]. End of fleshy fibres.

The *aponeurosis* of the external oblique, which is wider at the lower than at the upper part, and is larger than that of either of the other abdominal muscles, covers the fore part of the abdomen, and terminates by uniting with that of the opposite muscle along the median line[12], from the ensiform cartilage to the symphysis pubis. The upper part of the aponeurosis is connected with the larger pectoral muscle. Its lower fibres are closely aggregated together, and extended across from the anterior superior iliac spine to the pubes, in the form of a broad band[11], which is called Fallopius', or more commonly *Poupart's ligament.* This band is curved at the middle and outer parts, the convexity of the curve being directed towards the thigh ; and it is connected with the fascia lata of the limb. Aponeurosis; its large size; covers abdomen in front. Poupart's ligament.

Near the pubes the fibres of the aponeurosis diverge from one another, leaving between them a triangular opening, called the *external abdominal ring*[10], for the passage of the spermatic cord in the male, and the round ligament in the female. The direction of this opening is upwards and outwards, its base being formed by the pubic crest, and its sides by the two sets of diverging fibres called the *pillars.* One of these is attached to the anterior surface of the symphysis pubis, interlacing with the corresponding fibres of the opposite muscle ; the other pillar, which is the part before mentioned as Poupart's ligament, is external and inferior to the preceding, and is fixed to the pubic spinous process ; whilst a third portion, reflected backwards and outwards from the latter, with which it is continuous, is inserted along the pectineal line. This last small part is triangular in form, and nearly horizontal in direction, and is considered to be a third insertion of the muscle into the hip bone :—it is in reality but a portion of the internal extremity of Poupart's ligament, which being expanded has here a broad connection with the bone. Upon the aponeurosis are laid a series of oblique or transverse fibres ; some of them commencing from a narrow bundle over the outer part of Poupart's ligament, are directed inwards across the diverging fibres forming the pillars, binding these External abdominal ring is triangular. Its pillars. Insertion into symphysis and pubes. Transverse fibres, or inter-columnar.

together ; and a delicate web stretching between the pillars of the abdominal ring, and hence named *inter-columnar fascia*, gives a very thin prolongation downwards to the cord occupying that aperture.

Parts adjacent to muscle.

The external oblique muscle is covered by the superficial fascia, which in some cases is loaded with a large quantity of fat. It conceals the internal oblique and the inter-costal muscles. The posterior margin is overlapped in part by the latissimus dorsi.

Dissection of internal oblique.

To expose the internal oblique muscle.—When the external oblique muscle has been examined, it may be detached and reflected so as to bring into view the one subjacent to it, by cutting through its muscular fibres midway between its digitations and the margin of the ribs. Its posterior, or free border, will be found extending from the last rib to the iliac crest, and can be readily distinguished from the internal oblique muscle by the different course of its fibres. When this is effected, the fleshy fibres can be dissected from the iliac crest as far as the spine, and the whole plane of muscle turned over to the opposite side. The internal oblique is thus exposed for two-thirds of its extent.

Internal oblique.

Origin of fibres.

Their different directions.

Interval above Poupart's ligament.

The *internal oblique* muscle, (fig. 113,[14]) (obliquus internus ; obliquus ascendens ; ilio-abdominalis ; ilio-lumbo-costi-abdominalis,) placed under cover of the preceding, is of an irregularly quadrilateral form. The fleshy fibres *arise* inferiorly from the external half, not unfrequently from two-thirds of the inner surface of Poupart's ligament, from the iliac crest for two-thirds of its length, also from the lumbar fascia (page 124) between the innominate bone and the last rib. From these attachments the fibres of the muscle pass in different directions, to be inserted as follows : those from Poupart's ligament, which are usually paler than the rest, arch downwards and inwards over the spermatic cord, or the round ligament of the uterus, to be fixed into the front of the pubes, and for half an inch into the pectineal line conjointly with those of the transversalis muscle, but behind the insertion of the tendon of the external oblique into that line. A small interval is left between the lower margin of the muscle and the inner end of Poupart's ligament. The fibres from the anterior part of the iliac crest pass horizontally inwards, whilst the rest scend obliquely ; they terminate,—some in an aponeurosis xpanded in front of the abdomen, the rest at the lower of the cartilages of the last three ribs, on a level nternal inter-costal muscles.

The *aponeurosis* continues the muscle to the middle line in front, where it joins with that from the opposite side of the body, and extends from the margin of the thorax to the pubes. It is wider at the upper than the lower end. At the outer border of the rectus muscle this structure divides into two layers, one passing before, the other behind that muscle; and they reunite at its inner border, so as to enclose it in a sheath. The anterior layer becomes identified with the aponeurosis of the external oblique muscle, and the posterior one with that of the transversalis. The upper border of the posterior lamina is attached to the margin of the first false rib, and the last true one, as well as to the ensiform cartilage. Towards the lower part of the abdomen, (between the umbilicus and the pubes,) the aponeurosis is undivided and is altogether in front of the rectus. Aponeurosis divides into layers to sheathe the rectus.

The internal oblique muscle is covered by the external oblique, and behind, to a small extent, by the latissimus dorsi. It lies on the transversalis. At the anterior ends of the last two inter-costal spaces the fibres are continuous with those of the internal inter-costal muscles. Parts adjacent. Continuous with internal inter-costal.

To expose the transversalis muscle.—After the examination of the internal oblique muscle has been completed, if the fibres are rendered tense by pressing the thumb and fore-finger of the left hand on them, they can be divided, with perfect precision, without interfering with the subjacent muscle; for the fibres are retracted when divided, and, after about three parts are cut through, the interval between the muscles begins to be perceived, which, with the difference in the direction of their fibres, affords an unerring guide to their line of separation. Moreover, near the iliac spine and crest, these muscles are separated by the circumflex (ilii) vessels; and this is the part usually selected for cutting through the internal oblique, in order to expose the transversalis. When the line of separation is found, the muscular fibres should be detached from the crista ilii far back towards the lumbar region; after which they may be dissected from the cartilages of the ribs by insinuating the scalpel between the two planes of fibres, and then turning it so as to cut outwards. In this way the internal oblique muscle may be detached, and reflected to the opposite side, so as to expose the transversalis. Dissection for the transversalis.

The *transversalis* muscle (fig. 125,[4]) (transversalis v. transversus abdominis; lumbo-abdominalis) is subjacent to the internal oblique, and of the same form. It *arises* from the iliac third of Poupart's ligament; from the inner margin of the crista ilii for two-thirds of the length; from the cartilages of the last six ribs on the inner surface; and in the space Transversalis. Origin.

intermediate between the crista ilii and the ribs, from an aponeurosis which is attached to the transverse processes of the lumbar vertebræ (see fascia lumborum).

Fig. 125.*

Ending of fibres.

From these different points of origin the fibres pass horizontally forwards, and near the border of the rectus muscle they end in an aponeurosis,[5] which unites with the posterior layer of the internal oblique, and, together with it, joins that of the opposite side at the linea alba.

Aponeurosis beneath that of internal oblique.

The inferior fibres curve downwards, and are inserted into the front of the pubes and into the pectineal line for about an inch with, but beneath the internal oblique tendon; and some fibrous bands join the fascia transversalis. This insertion is intimately connected with that of the internal oblique, and both together have received the name of the *conjoined tendon*[6] of these muscles.

Conjoined tendon of internal oblique and transversalis.

Inter-digitates with diaphragm.

At its attachment to the under surface of the cartilages of the ribs, the transversalis digitates with the diaphragm. This muscle is lined by the fascia transversalis which separates it from the peritoneum.

The lower parts of the three foregoing muscles, and the manner of their connection with the spermatic cord or the round ligament of the uterus, together with the cremaster muscle and other coverings given to the cord in this situation, will be considered in the account of the "inguinal region."

Dissection of the rectus.

To expose the rectus muscle.—The sheath of the rectus muscle should in the next place be examined. When this is being done, the connections of the sheath with transverse tendinous bands, which

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* 1, 2. External and internal inter-costal muscles. 3. Rectus. 4. Transversalis; and 5, its aponeurosis. 6. The conjoined tendon of internal oblique and transversalis. 7. The internal abdominal ring.—The ...ency of the posterior lamina of the sheath of the rectus, which ... towards the lower end, is not indicated in this figure.

intersect the muscle, must be cut through. Its anterior layer must be divided in its whole length, by an incision drawn down from the margin of the thorax to the pubes, and then reflected off the rectus. By inserting the handle of the scalpel beneath the outer border of the muscle, this may be raised, and the posterior layer of the sheath brought into view. Lastly, if the muscle be cut across midway between the umbilicus and pubes, and the two parts drawn aside, the point at which the sheath is imperfect, posteriorly, can be determined by pushing the handle of the scalpel against it, so as to separate it from the subjacent membrane.

Rectus abdominis (fig. 109,[16]; fig. 121,[3]) (sterno-pubius).— This long, narrow, and flat muscle is situate at the fore part of the abdomen; it is separated from the muscle of the other side by a narrow interval, which is wider at the upper than towards the lower end, and is occupied by fibrous structure (linea alba). It *arises* from the pubes by two tendons; of which the internal is much the smaller, and is connected to the ligaments covering the pubic symphysis, while the external one is fixed to the pubic crest. Expanding and becoming thinner at the upper end, the muscle is *inserted* into the cartilages of three ribs, (fifth, sixth and seventh,) and usually by three distinct parts of unequal size. In some cases a few fibres will be found attached to the ensiform cartilage.

Rectus.

Two parts of origin.

Insertion into ribs.

The fibres are interrupted by three irregular tendinous intersections,—*lineæ transversæ*; one of these is opposite the umbilicus, another on a level with the ensiform cartilage, and the third is intermediate between them. Their number is in some cases augmented to four or even five, and the additional intersections are then placed below the umbilicus. These bands do not usually penetrate the whole substance of the muscle, and some of them extend only half way across it.—The epigastric artery is placed behind the rectus muscle.

Lineæ transversæ;

their number and its variations.

The rectus is enclosed in a sheath—*sheath of the rectus*— formed by the aponeuroses of the abdominal muscles, in the following manner:—The aponeurosis of the internal oblique, on arriving at the external border of the rectus, divides into two layers; of which the anterior one passes in front of the muscle, together with the aponeurosis of the external oblique, whilst the other is placed behind it, conjointly with that of the transversalis; and both are again united at the inner margin of the muscle along the linea alba. This arrangement obtains from the margin of the thorax, as far as to midway between the umbilicus and the pubes, but at this

Sheath of rectus.

Aponeurosis of internal oblique splits.

point all the aponeuroses pass in front of the rectus ; so that the posterior part of the sheath is deficient in the lower third, the muscle being separated from the peritoneum only by the fascia transversalis. The deficiency in the sheath here indicated is usually marked by a well-defined lunated edge, whose concavity looks downwards towards the pubes. The sheath is firmly connected in front with the tendinous bands by which the muscle is intersected.

Sheath incomplete at lower part of abdomen.

Its connection with lineæ transversæ.

Pyramidalis.

The *pyramidalis* muscle, (fig. 113,[17]) triangular in its form with the base below and the apex upwards, and situate close to the linea alba, arises from the front of the pubes and the ligaments of the symphysis ; and becoming narrow as it ascends, and extending over about a third of the interval between the umbilicus and pubes, is inserted into the linea alba, of which it may be considered as a tensor muscle. It is covered in front by the aponeurosis of the other muscles, and rests posteriorly on the rectus, to which it is in some degree accessory, for the size of the lower part of this muscle is augmented when the pyramidalis is wanting.

Connection with linea alba.

Often absent.

This little muscle is often absent on one or both sides, and in some instances has been found to be double. It occasionally exceeds the ordinary length above stated.

—Some tendinous structures, which have already been incidentally referred to, require a special notice in this place, viz. the linea alba, linea semi-lunaris, and lineæ transversæ.

Linea alba ;

The *linea alba* may be considered as a tendinous cord (fig. 113,[12]) extended perpendicularly downwards from the ensiform cartilage to the pubes, and formed by the juncture of the aponeuroses of the two oblique and the transverse muscles, the tendinous fibres being continued from the muscles of one side to those of the other. Some longitudinal fibres are distinguishable towards its lower end. This structure is covered in front by the common integument ; posteriorly it rests on the fascia transversalis, which separates it from the peritoneum ; and on each side it is limited by the recti muscles ; it must therefore be broader above than below, as these muscles diverge from one another in the former situation. In the linea alba below its middle is situate the *umbilicus*, which in the fœtal state is a foramen for the transmission of the umbilical vein and arteries, but afterwards becomes obliterated.

how formed ;

connections.

Umbilicus.

Lineæ semilunares.

The *lineæ semi-lunares* are two curved tendinous lines

extending, one on each side, from the cartilage of the eighth rib to the pubic tuberosity of the hip-bone. They thus correspond with the external border of the recti muscles, and are formed by the aponeurosis of the internal oblique on each side, as this divides to enclose the rectus muscle.

The *lineæ transversæ* have been already noticed with the rectus muscle, as the tendinous bands which cross the substance of that muscle.

The *quadratus lumborum* (fig. 112,[16]) (ilio-costalis,) situate deeply in the lumbar region close to the vertebral column, is in form irregularly quadrilateral, being somewhat broader below than above. One part *arises* by fleshy and tendinous fibres from the ilio-lumbar ligament, and about two inches of the iliac crest of the innominate bone opposite that band; it is *inserted* into the inferior border of the last rib for about half the length, and by four tendinous points into the transverse processes (parapophyses) of the four superior lumbar vertebræ. Another series of fibres, *arising* by two or three tendinous points from as many of the inferior transverse processes at their upper margins, passes in front of those inserted into the same processes, and joins with the part of the muscle attached to the rib. This muscle is enclosed in a sheath resembling that of the rectus, but not so dense or firm in its structure (see the fascia lumborum).

Quadratus lumborum. Two sets of fibres. First series. Second set of fibres. The sheath.

The number of the points of insertion of this muscle to the vertebræ, and the extent of its connection with the last rib, vary in different cases. It is in some instances attached to the last dorsal vertebra—the body or transverse process.

Variations in size and attachments.

Dissection to show the fascia lumborum.—If the internal oblique be traced back, its muscular fibres will be found to be attached to the membranous elongation from the transversalis. If attention is directed to the tendon of the latissimus dorsi, this will be seen also to be connected with the same tendon of the transversalis. Now, if the aponeurosis of the latissimus be divided in the middle of its breadth, by an incision drawn from the hip-bone to the last rib, and the two parts reflected, the thick mass of lumbar muscles will be exposed; and if the handle of the scalpel be inserted beneath their outer border, they will be found to lie on a membrane, which is connected with the lumbar vertebræ on the one hand, and with the abdominal muscles on the other, being, in fact, a tendon of one of the latter (the transversalis). The mass of lumbar muscles may now be cut across by two incisions, one opposite the last rib, the other at the crista ilii, and then removed altogether. In this stage of the dissection the transversalis tendon or aponeurosis will be found stretching back to the transverse processes of the lumbar vertebræ. If this be divided by a perpendicular incision from the last rib to the pelvis, the

Dissection of fascia lumborum.

an exception, inasmuch as it reaches for some space above the margin of the ribs, and in so far forms a portion of the walls of the thorax.

The parts just reviewed in their combination will now be examined singly.

Dissection of the outer muscle.

Dissection.—To expose the external oblique muscle:—When commencing the dissection of the abdominal muscles, an incision may be made through the skin from the ensiform cartilage to the umbilicus, and another thence to the most depending part of the margin of the thorax. The angular flap of skin, bounded by these lines, may be easily reflected by commencing at its point, and taking the tendinous fibres of the external oblique muscle as a guide, each stroke of the scalpel being directed obliquely upwards and outwards. The flap should be reflected until its base, or attached border, is brought on a line with the ensiform cartilage, or somewhat higher, which is necessary in order to expose the digitated processes of the muscle and their intermixture with those of the serratus magnus. An incision may, in the next place, be carried horizontally inwards from the anterior superior iliac spinous process to the linea alba, and be there met by another drawn down from the umbilicus. The enclosed flap of skin should be reflected back to the posterior part of the lumbar region. If it be required to exhibit the muscle in its entire extent, the portion of integument still remaining on the lower part of the abdomen may be divided by an incision drawn from the pubes upwards, and the flap reflected down over Poupart's ligament. For the present, however, the integument, muscle, &c., in the iliac region will be left untouched, as they will require to be examined attentively when treating of the dissection of the parts connected with hernia.

External oblique;

largest of lateral muscles.

The *external oblique* muscle of the abdomen, (fig. 109,[9]) (obliquus externus abdominis ; obliquus descendens ; costo-abdominalis ; ilio-pubi-costo-abdominalis,) the largest of the three side muscles, is situate on the lateral and anterior aspects of the abdomen, and consists of two parts ; one, muscular, occupies the side of the abdomen ; the other, aponeurotic, extends over the front of that cavity.

Origin.

Broad, thin, and irregularly quadrilateral in form, this muscle *arises* from the anterior surface of the eight inferior ribs, by fibres arranged in so many angular processes named digitations. These are placed between similarly formed parts (digitations) of the serratus magnus and latissimus dorsi (five in connection with the former, and three with the latter), in the manner the fingers of one hand may be interposed between those of the other ; and it is from this circumstance that the processes are named. The lower and the upper digitations of the muscle are connected with the ribs near their cartilages, but those in the middle are attached at some distance from these ; the lowest embraces

Inter-digitates with serratus and latissimus dorsi.

the point of the twelfth rib. The fleshy fibres from the last ribs pass down in nearly a vertical direction to be *inserted* into the external margin of the iliac crest of the hip bone for about the anterior half of its length ; all the rest incline downwards and forwards, and terminate in tendinous fibres, which form a broad aponeurosis[13]. End of fleshy fibres.

The *aponeurosis* of the external oblique, which is wider at the lower than at the upper part, and is larger than that of either of the other abdominal muscles, covers the fore part of the abdomen, and terminates by uniting with that of the opposite muscle along the median line[12], from the ensiform cartilage to the symphysis pubis. The upper part of the aponeurosis is connected with the larger pectoral muscle. Its lower fibres are closely aggregated together, and extended across from the anterior superior iliac spine to the pubes, in the form of a broad band[11], which is called Fallopius', or more commonly *Poupart's ligament*. This band is curved at the middle and outer parts, the convexity of the curve being directed towards the thigh ; and it is connected with the fascia lata of the limb. Aponeurosis; its large size; covers abdomen in front. Poupart's ligament.

Near the pubes the fibres of the aponeurosis diverge from one another, leaving between them a triangular opening, called the *external abdominal ring*[10], for the passage of the spermatic cord in the male, and the round ligament in the female. The direction of this opening is upwards and outwards, its base being formed by the pubic crest, and its sides by the two sets of diverging fibres called the *pillars*. One of these is attached to the anterior surface of the symphysis pubis, interlacing with the corresponding fibres of the opposite muscle ; the other pillar, which is the part before mentioned as Poupart's ligament, is external and inferior to the preceding, and is fixed to the pubic spinous process ; whilst a third portion, reflected backwards and outwards from the latter, with which it is continuous, is inserted along the pectineal line. This last small part is triangular in form, and nearly horizontal in direction, and is considered to be a third insertion of the muscle into the hip bone :—it is in reality but a portion of the internal extremity of Poupart's ligament, which being expanded has here a broad connection with the bone. Upon the aponeurosis are laid a series of oblique or transverse fibres ; some of them commencing from a narrow bundle over the outer part of Poupart's ligament, are directed inwards across the diverging fibres forming the pillars, binding these External abdominal ring is triangular. Its pillars. Insertion into symphysis and pubes. Transverse fibres, or inter-columnar.

together; and a delicate web stretching between the pillars of the abdominal ring, and hence named *inter-columnar fascia*, gives a very thin prolongation downwards to the cord occupying that aperture.

Parts adjacent to muscle.

The external oblique muscle is covered by the superficial fascia, which in some cases is loaded with a large quantity of fat. It conceals the internal oblique and the inter-costal muscles. The posterior margin is overlapped in part by the latissimus dorsi.

Dissection of internal oblique.

To expose the internal oblique muscle.—When the external oblique muscle has been examined, it may be detached and reflected so as to bring into view the one subjacent to it, by cutting through its muscular fibres midway between its digitations and the margin of the ribs. Its posterior, or free border, will be found extending from the last rib to the iliac crest, and can be readily distinguished from the internal oblique muscle by the different course of its fibres. When this is effected, the fleshy fibres can be dissected from the iliac crest as far as the spine, and the whole plane of muscle turned over to the opposite side. The internal oblique is thus exposed for two-thirds of its extent.

Internal oblique.

The *internal oblique* muscle, (fig. 113,[14]) (obliquus internus; obliquus ascendens; ilio-abdominalis; ilio-lumbo-costi-abdominalis,) placed under cover of the preceding, is of an irregularly quadrilateral form.

Origin of fibres.

The fleshy fibres *arise* inferiorly from the external half, not unfrequently from two-thirds of the inner surface of Poupart's ligament, from the iliac crest for two-thirds of its length, also from the lumbar fascia (page 124) between the innominate bone and the last rib. From these attachments the fibres of the muscle pass in different directions, to be inserted as follows:

Their different directions.

those from Poupart's ligament, which are usually paler than the rest, arch downwards and inwards over the spermatic cord, or the round ligament of the uterus, to be fixed into the front of the pubes, and for half an inch into the pectineal line conjointly with those of the transversalis muscle, but behind the insertion of the tendon of the external oblique into that line.

Interval above Poupart's ligament.

A small interval is left between the lower margin of the muscle and the inner end of Poupart's ligament. The fibres from the anterior part of the iliac crest pass horizontally inwards, whilst the rest ascend obliquely; they terminate,—some in an aponeurosis expanded in front of the abdomen, the rest at the lower margin of the cartilages of the last three ribs, on a level with the internal inter-costal muscles.

The *aponeurosis* continues the muscle to the middle line in front, where it joins with that from the opposite side of the body, and extends from the margin of the thorax to the pubes. It is wider at the upper than the lower end. At the outer border of the rectus muscle this structure divides into two layers, one passing before, the other behind that muscle; and they reunite at its inner border, so as to enclose it in a sheath. The anterior layer becomes identified with the aponeurosis of the external oblique muscle, and the posterior one with that of the transversalis. The upper border of the posterior lamina is attached to the margin of the first false rib, and the last true one, as well as to the ensiform cartilage. Towards the lower part of the abdomen, (between the umbilicus and the pubes,) the aponeurosis is undivided and is altogether in front of the rectus.

Aponeurosis divides into layers to sheathe the rectus.

The internal oblique muscle is covered by the external oblique, and behind, to a small extent, by the latissimus dorsi. It lies on the transversalis. At the anterior ends of the last two inter-costal spaces the fibres are continuous with those of the internal inter-costal muscles.

Parts adjacent.

Continuous with internal intercostal.

To expose the transversalis muscle.—After the examination of the internal oblique muscle has been completed, if the fibres are rendered tense by pressing the thumb and fore-finger of the left hand on them, they can be divided, with perfect precision, without interfering with the subjacent muscle; for the fibres are retracted when divided, and, after about three parts are cut through, the interval between the muscles begins to be perceived, which, with the difference in the direction of their fibres, affords an unerring guide to their line of separation. Moreover, near the iliac spine and crest, these muscles are separated by the circumflex (ilii) vessels; and this is the part usually selected for cutting through the internal oblique, in order to expose the transversalis. When the line of separation is found, the muscular fibres should be detached from the crista ilii far back towards the lumbar region; after which they may be dissected from the cartilages of the ribs by insinuating the scalpel between the two planes of fibres, and then turning it so as to cut outwards. In this way the internal oblique muscle may be detached, and reflected to the opposite side, so as to expose the transversalis.

Dissection for the transversalis.

The *transversalis* muscle (fig. 125,[4]) (transversalis v. transversus abdominis; lumbo-abdominalis) is subjacent to the internal oblique, and of the same form. It *arises* from the iliac third of Poupart's ligament; from the inner margin of the crista ilii for two-thirds of the length; from the cartilages of the last six ribs on the inner surface; and in the space

Transversalis.

Origin.

intermediate between the crista ilii and the ribs, from an aponeurosis which is attached to the transverse processes of the lumbar vertebræ (see fascia lumborum).

Fig. 125.*

Ending of fibres.

From these different points of origin the fibres pass horizontally forwards, and near the border of the rectus muscle they end in an aponeurosis,[5] which unites with the posterior layer of the internal oblique, and, together with it, joins that of the opposite side at the linea alba. The inferior fibres curve downwards, and are inserted into the front of the pubes and into the pectineal line for about an inch with, but beneath the internal oblique tendon; and some fibrous bands join the fascia transversalis. This insertion is intimately connected with that of the internal oblique, and both together have received the name of the *conjoined tendon*[6] of these muscles.

Aponeurosis beneath that of internal oblique.

Conjoined tendon of internal oblique and transversalis.

Inter-digitates with diaphragm.

At its attachment to the under surface of the cartilages of the ribs, the transversalis digitates with the diaphragm. This muscle is lined by the fascia transversalis which separates it from the peritoneum.

The lower parts of the three foregoing muscles, and the manner of their connection with the spermatic cord or the round ligament of the uterus, together with the cremaster muscle and other coverings given to the cord in this situation, will be considered in the account of the "inguinal region."

Dissection of the rectus.

To expose the rectus muscle.—The sheath of the rectus muscle should in the next place be examined. When this is being done, the connections of the sheath with transverse tendinous bands, which

* 1, 2. External and internal inter-costal muscles. 3. Rectus. 4. Transversalis; and 5, its aponeurosis. 6. The conjoined tendon of internal oblique and transversalis. 7. The internal abdominal ring.—The deficiency of the posterior lamina of the sheath of the rectus, which occurs towards the lower end, is not indicated in this figure.

intersect the muscle, must be cut through. Its anterior layer must be divided in its whole length, by an incision drawn down from the margin of the thorax to the pubes, and then reflected off the rectus. By inserting the handle of the scalpel beneath the outer border of the muscle, this may be raised, and the posterior layer of the sheath brought into view. Lastly, if the muscle be cut across midway between the umbilicus and pubes, and the two parts drawn aside, the point at which the sheath is imperfect, posteriorly, can be determined by pushing the handle of the scalpel against it, so as to separate it from the subjacent membrane.

Rectus abdominis (fig. 109,[16]; fig. 121,[3]) (sterno-pubius).— This long, narrow, and flat muscle is situate at the fore part of the abdomen; it is separated from the muscle of the other side by a narrow interval, which is wider at the upper than towards the lower end, and is occupied by fibrous structure (linea alba). It *arises* from the pubes by two tendons; of which the internal is much the smaller, and is connected to the ligaments covering the pubic symphysis, while the external one is fixed to the pubic crest. Expanding and becoming thinner at the upper end, the muscle is *inserted* into the cartilages of three ribs, (fifth, sixth and seventh,) and usually by three distinct parts of unequal size. In some cases a few fibres will be found attached to the ensiform cartilage.

Rectus. Two parts of origin. Insertion into ribs.

The fibres are interrupted by three irregular tendinous intersections,—*lineæ transversæ;* one of these is opposite the umbilicus, another on a level with the ensiform cartilage, and the third is intermediate between them. Their number is in some cases augmented to four or even five, and the additional intersections are then placed below the umbilicus. These bands do not usually penetrate the whole substance of the muscle, and some of them extend only half way across it.—The epigastric artery is placed behind the rectus muscle.

Lineæ transversæ; their number and its variations.

The rectus is enclosed in a sheath—*sheath of the rectus*— formed by the aponeuroses of the abdominal muscles, in the following manner:—The aponeurosis of the internal oblique, on arriving at the external border of the rectus, divides into two layers; of which the anterior one passes in front of the muscle, together with the aponeurosis of the external oblique, whilst the other is placed behind it, conjointly with that of the transversalis; and both are again united at the inner margin of the muscle along the linea alba. This arrangement obtains from the margin of the thorax, as far as to midway between the umbilicus and the pubes, but at this

Sheath of rectus. Aponeurosis of internal oblique splits.

point all the aponeuroses pass in front of the rectus; so that the posterior part of the sheath is deficient in the lower third, the muscle being separated from the peritoneum only by the fascia transversalis. The deficiency in the sheath here indicated is usually marked by a well-defined lunated edge, whose concavity looks downwards towards the pubes. The sheath is firmly connected in front with the tendinous bands by which the muscle is intersected.

Sheath incomplete at lower part of abdomen.

Its connection with lineæ transversæ.

Pyramidalis.

The *pyramidalis* muscle, (fig. 113,[17]) triangular in its form with the base below and the apex upwards, and situate close to the linea alba, arises from the front of the pubes and the ligaments of the symphysis; and becoming narrow as it ascends, and extending over about a third of the interval between the umbilicus and pubes, is inserted into the linea alba, of which it may be considered as a tensor muscle. It is covered in front by the aponeurosis of the other muscles, and rests posteriorly on the rectus, to which it is in some degree accessory, for the size of the lower part of this muscle is augmented when the pyramidalis is wanting.

Connection with linea alba.

Often absent.

This little muscle is often absent on one or both sides, and in some instances has been found to be double. It occasionally exceeds the ordinary length above stated.

—Some tendinous structures, which have already been incidentally referred to, require a special notice in this place, viz. the linea alba, linea semi-lunaris, and lineæ transversæ.

Linea alba;

The *linea alba* may be considered as a tendinous cord (fig. 113,[15]) extended perpendicularly downwards from the ensiform cartilage to the pubes, and formed by the juncture of the aponeuroses of the two oblique and the transverse muscles, the tendinous fibres being continued from the muscles of one side to those of the other. Some longitudinal fibres are distinguishable towards its lower end. This structure is covered in front by the common integument; posteriorly it rests on the fascia transversalis, which separates it from the peritoneum; and on each side it is limited by the recti muscles; it must therefore be broader above than below, as these muscles diverge from one another in the former situation. In the linea alba below its middle is situate the *umbilicus*, which in the fœtal state is a foramen for the transmission of the umbilical vein and arteries, but afterwards becomes obliterated.

how formed;

connections.

Umbilicus.

Lineæ semi-lunares.

The *lineæ semi-lunares* are two curved tendinous lines

extending, one on each side, from the cartilage of the eighth rib to the pubic tuberosity of the hip-bone. They thus correspond with the external border of the recti muscles, and are formed by the aponeurosis of the internal oblique on each side, as this divides to enclose the rectus muscle.

The *lineæ transversæ* have been already noticed with the rectus muscle, as the tendinous bands which cross the substance of that muscle.

The *quadratus lumborum* (fig. 112,[16]) (ilio-costalis,) situate deeply in the lumbar region close to the vertebral column, is in form irregularly quadrilateral, being somewhat broader below than above. One part *arises* by fleshy and tendinous fibres from the ilio-lumbar ligament, and about two inches of the iliac crest of the innominate bone opposite that band; it is *inserted* into the inferior border of the last rib for about half the length, and by four tendinous points into the transverse processes (parapophyses) of the four superior lumbar vertebræ. Another series of fibres, *arising* by two or three tendinous points from as many of the inferior transverse processes at their upper margins, passes in front of those inserted into the same processes, and joins with the part of the muscle attached to the rib. This muscle is enclosed in a sheath resembling that of the rectus, but not so dense or firm in its structure (see the fascia lumborum).

Quadratus lumborum.

Two sets of fibres.

First series.

Second set of fibres.

The sheath.

The number of the points of insertion of this muscle to the vertebræ, and the extent of its connection with the last rib, vary in different cases. It is in some instances attached to the last dorsal vertebra—the body or transverse process.

Variations in size and attachments.

Dissection to show the fascia lumborum.—If the internal oblique be traced back, its muscular fibres will be found to be attached to the membranous elongation from the transversalis. If attention is directed to the tendon of the latissimus dorsi, this will be seen also to be connected with the same tendon of the transversalis. Now, if the aponeurosis of the latissimus be divided in the middle of its breadth, by an incision drawn from the hip-bone to the last rib, and the two parts reflected, the thick mass of lumbar muscles will be exposed; and if the handle of the scalpel be inserted beneath their outer border, they will be found to lie on a membrane, which is connected with the lumbar vertebræ on the one hand, and with the abdominal muscles on the other, being, in fact, a tendon of one of the latter (the transversalis). The mass of lumbar muscles may now be cut across by two incisions, one opposite the last rib, the other at the crista ilii, and then removed altogether. In this stage of the dissection the transversalis tendon or aponeurosis will be found stretching back to the transverse processes of the lumbar vertebræ. If this be divided by a perpendicular incision from the last rib to the pelvis, the

Dissection of fascia lumborum.

quadratus lumborum will come into view; and, if the external border of this muscle be raised, another thin layer will be found resting on its abdominal surface, and connected with the roots of the transverse processes.

Fascia lumborum or transversalis tendon.

Fascia lumborum.—The two membranous layers now brought into view, together with the tendon of the transversalis, have received this name. The tendon of the muscle (posterior aponeurosis of the transversalis) occupies the interval between the two last ribs and the iliac crest, being attached to both, and is pierced by the last dorsal and ilio-hypogastric nerves. From its inner part two offsets extend backwards to the lumbar vertebræ, encasing the quadratus lumborum. That which is in front of the muscle is very thin, and is attached to the anterior part of the transverse processes (parapophyses) of the vertebræ at their roots, and superiorly, where it is connected with the last rib, it forms the ligamentum arcuatum externum of the diaphragm. The posterior layer, which is much thicker than the preceding, is attached to the points and the margins of the same transverse processes; it separates the quadratus lumborum from the large muscular mass behind it.

Two offsets encase quadratus;

The internal oblique muscle springs from the fascia, and the tendon of the latissimus dorsi is connected with it farther back, viz. at the outer margin of the erector spinæ. And thus while the quadratus is sheathed by the layers of the fascia lumborum, the erector spinæ is encased by one of the offsets (the hinder) of that fascia and the tendon of the latissimus dorsi, which are joined at its outer margin.

and separate it from erector spinæ.

Action of muscles on viscera;

Actions of the abdominal muscles. — The muscles here described not only enclose and support the abdominal viscera, but by their contractile power are capable of acting successively on them, on the thorax, and on the pelvis. When the pelvis and thorax are fixed, the abdominal muscles can constrict the cavity and compress the viscera, particularly if the diaphragm be made to descend at the same time, as occurs in vomiting and in the expulsion of the fœtus, the fæces, and the urine.

on thorax and trunk.

If the vertebral column be fixed, these muscles compress the lower border of the thorax, and so contribute to expiration, and when it is intended to continue the effort, so as to produce a forced expiration, the quadratus lumborum draws down the last rib; but if the vertebral column be not fixed, the thorax may be bent directly forwards, when the muscles of both sides act, or it may be rotated to either

side, should they act alternately. Thus, if the external oblique of the right side be made to act on the thorax, the first effect appears to be that of drawing its margin down towards the pelvis; but, if the effort be continued, the trunk will be rotated towards the opposite side. The left internal oblique will co-operate in this action, for the direction of its fibres coincides with that of the right external oblique. The pyramidales also contribute to the same effect, by rendering the linea alba tense.

If the thorax be fixed, the abdominal muscles may be made to act on the pelvis; thus, in the action of climbing, the trunk and arms being elevated and fixed, the pelvis is drawn upwards, either directly or to one side, as a preparatory step to the elevation of the lower limbs. A similar effect may be produced when the trunk is in the horizontal position, for the pelvis may be drawn forward and flexed upon the vertebral column by the recti and pyramidales. On pelvis.

COSTAL REGION.

Between the ribs are two planes of muscular fibres filling up the intervening spaces, and thus named "inter-costal;" upon the ribs posteriorly are the levatores costarum; and at their inner surface, in front, the triangulares sterni.

It is not necessary to prescribe any particular mode of examining these, as they are necessarily perceived when the pectoral, the serratus, and external oblique muscles are removed.

The inter-costal muscles are disposed in the form of two thin planes, one over another, and named from their relative position "external" and "internal." Inter-costales.

The *external inter-costal* muscles (inter-costales externi) are placed between the contiguous borders of each pair of ribs: there are therefore eleven such muscular layers on each side. The direction of the fibres of all is oblique downwards and forwards (fig. 125,[1]). Their extent for the most part is from the tubercles of the ribs nearly to the external extremity of the cartilages; but in the two lowest spaces they reach the end of the ribs: from the point of ending a thin fascia is continued forwards to the sternum, overlaying the inner inter-costals. There are many tendinous fibres mixed up with the muscular structure. External. Number. Extent.

The external inter-costal muscles are covered by several large muscles, which are attached to the ribs. They conceal the corresponding internal muscle with the inter-costal nerves and vessels.

Internal inter-costals. The *internal inter-costal* muscles, (inter-costales interni) (fig. 125,[2]) placed under the preceding, are attached to the inner margins of the ribs and their cartilages. Commencing at the sternum in the spaces between the true ribs, and at

Extent. the anterior extremities of the cartilages of the false ribs, they extend as far back as the angles of those bones. The fibres incline downwards and backwards, and decussate with or cross the former; but they are somewhat shorter and less oblique in their direction.

The internal are separated from the external inter-costal muscles at the back of the spaces by the inter-costal vessels and nerves; they are lined internally by the pleura.

Infra-costales. *Infra-costales* (Verheyen).—In connection with the inner surface of the ribs several small bundles of fleshy and ten-

Cross ribs at inner surface. dinous fibres will be found extending over two, and in some instances over three inter-costal spaces. They have the same direction as the internal inter-costals, and are often

Irregular in number. described as parts of those muscles. The fasciculi vary in size and number, and may cover all the inter-costal spaces, except perhaps the first, but they are most constant on the lower ribs.

Levatores costarum. The *levatores costarum* (levatores breviores costarum,—Alb.) (fig. 112,[17]) are narrow tendinous and fleshy fasciculi, which extend obliquely downwards and forwards (in this

One to each rib. particular resembling the external inter-costals), from the extremities of the transverse processes of the dorsal vertebræ, and are inserted into the upper margin of the ribs between the angle and tubercle. Their fibres spread out and become flat at their insertion. Each rib receives one from the vertebra next above; there are therefore twelve muscles on each side, and that for the first rib comes from the transverse process of the last cervical vertebra.

Lower are attached to two ribs. The inferior muscles of this series divide into two parts; one of these is distributed as above stated, but the other consisting of longer fibres passes over one rib, and terminates on the second below; and thus each of these ribs receives muscular fibres from the transverse processes of two vertebræ. The longer bundles have been described as separate muscles under the name *levatores longiores costarum* (Albinus).

The *triangularis sterni* (sterno-costales,—Verheyen) is a thin stratum of muscular and tendinous fibres placed within the thorax, immediately behind the costal cartilages. This muscle *arises* from the inner surface of the ensiform cartilage, of the lower part of the sternum, and of the cartilages of the three or four lower true ribs. Its fibres pass outwards and upwards diverging, the lowest being horizontal, the rest oblique, and approaching more and more the vertical direction towards the upper part of the muscle; and are inserted by digitations (which give to the outer margin a serrated appearance) into the cartilages of the true ribs from the fifth to the second inclusive—on the lower border and inner surface of each, at the junction with the bony part.

Triangularis sterni is in thorax.

Attachments.

One surface of the triangularis sterni is in apposition with the parts just mentioned, together with the internal mammary artery and the internal inter-costal muscle; the other surface is in contact partly with the pleura, which is reflected upon it, and partly with the pericardium and the anterior mediastinum. At the lower margin the fibres are continuous with those of the transversalis muscle.

Connections.

The triangularis sterni varies constantly in its extent and points of attachment in different bodies, and even on the opposite sides of the same body.

Actions.—In this group of muscles the intercostals are the chief agents in producing the rib movements. By the action of the external intercostals the ribs are raised, and the chest enlarged. The internal intercostals have a different use at the side, and at the fore part of the thoracic wall. Thus, between the osseous portions of the ribs they act as depressors after the ribs have been raised, and diminish the size of the chest; but between the cartilages they take on the office of elevators, and assist the external stratum in dilating the thorax. Commonly, these muscles act alternately, but if they are made to contract simultaneously, they antagonise each other, and arrest the costal movement. The upper and lower ribs are provided with special elevators and depressors; but the ascent of the ribs as a whole does not require the fixedness of the upper ones, nor during their descent is it at all indispensable that the last ribs should be previously drawn down, for in fracture only the muscles in the spaces included by the broken bones become immoveable.

Action of external and internal intercostals: the last has a double office.

Ribs not drawn towards a fixed point.

During the expansion and diminution of the thorax the

Movement of ribs:

ribs are not simply separated and approximated, like the rays of a fan when this is opened and shut, but they are rotated as well as raised and lowered. The external intercostals, in raising the ribs, project especially the fore parts, and advance thereby the sternum, so as to give increase from before back to the thoracic cavity; and they evert the lower borders, enlarging in this way the interosseous spaces, and the transverse measurement of the capacity of the chest. The internal intercostals, when depressing the ribs, draw down the anterior ends, and turn inwards the lower borders; by reversing the action of the outer muscular layer, they diminish the intercostal spaces, and the size of the thorax in both directions.

they are raised and rotated out by external,

depressed and turned in by internal.

Costal muscles in respiration.

In ordinary respiration the ribs are raised by the external intercostals, aided by the levatores costarum, and the part of the internal intercostals between the rib cartilages. And the ribs are lowered by the other portions of the internal intercostals, by the infra-costals, and by the triangularis sterni which takes the place in front of an infra-costal depressor.

The actions of the special muscles on the upper and lower ribs are referred to with the description of those muscles.

Diaphragm; outline of its arrangement.

The *diaphragm* (fig. 126) (*διάφραγμα* * : *φρένες* : septum transversum: midriff) is a thin muscular and fibrous partition between the thorax and abdomen, and is perforated for the passage of certain organs from one to another of those cavities. From the lower margin of the thorax, to which it is attached at its circumference, the septum arches deeply upwards, and from this shape it results that some of the viscera situate at the upper part of the abdomen are, to a considerable extent, under the protection of the ribs; and as the height to which the septum arches is liable to variation, and is actually varied constantly during life, the capacity of the thorax and the abdomen is alternately enlarged and diminished,—the enlargement of the one coinciding with the diminution of the other. It is connected directly with the thorax at its anterior and lateral part: but as the aorta is placed immediately against the spine, and as the psoas muscles are attached to the sides of that column, at the same time as the last rib on each side is occupied by the quadratus lumborum,—the diaphragm is

* *Διαφράσσω*, to separate two parts.

separated from the bones by those bodies, and its fibres take origin from tendinous arches extending over them.

Origin of the fibres.—a. The crura (fig. 126,[9],[10]).—On the bodies of the lumbar vertebræ, and on each side of the Crura.

Fig. 126.*

aorta, is a thick tendinous band which consists of several sets of fibres. These tendinous fibres are usually aggregated into two bundles, and are attached over a considerable but varying extent of surface. On the right side they are connected with the first, second, and third lumbar vertebræ, and the interposed fibro-cartilages, or to the second, third, and fourth; on the left side, the attachment is shorter by the breadth of one vertebra. The tendons of both sides unite by their inner margins on the bones to which they are attached, and are continued into each other over the aorta by a small fibrous arch. Proceeding upwards they give origin to muscular fibres, and these with the tendons are named the *crura*, or sometimes the *pillars* of the diaphragm. The external muscular fibres emanating from this source are directed upwards and outwards to the aponeurotic centre;

Right lower than left.

Muscular fibres;

* A view of the lower surface of the diaphragm. 1, 2. Ligamenta arcuata—externum and internum. 3, 4. The muscles beneath the preceding. 5, 6, 7. The parts of the central tendon. 8. The foramen for the vena cava. 9, 10. The crura. 11. Hiatus aorticus. 12. The foramen for the œsophagus.

their decussation.

but the fibres nearest the middle line cross to the opposite side (those of the right being usually anterior to those from the left), and then curving upwards they construct an opening for the transmission of the œsophagus before ending in the common centre of the muscular fibres. The decussation of the fibres was found by Haller to be generally four-fold ; it measures about an inch in length.

Ligamenta arcuata.

b. Ligamenta arcuata.—Externally to the bodies of the vertebræ are two fibrous arches on each side.* The first[2] extends from the body of the first lumbar vertebra to the

Internal over psoas.

transverse process (parapophysis) of the same vertebra, or likewise to the second, and crosses over the psoas muscle. It is named the ligamentum arcuatum internum (arcus interior,—Haller). The second and broader fibrous arch[1]

External over quadratus lumborum :

(ligamentum arcuatum externum) reaches from the outer extremity of the preceding (both being attached to the same part,—the transverse process), over the quadratus lumborum, to the last rib. This band is continuous with the anterior lamina of the sheath of the muscle just mentioned, and is but the upper margin of that structure somewhat increased

give origin to muscular fibres.

in thickness. From both these tendinous bands muscular fibres take rise, and are directed to the posterior part of the common centre. Those above the last rib are usually thin, and separated by inter-spaces.

Origin from ribs ;

c. Origin from the ribs and the ensiform cartilage.—The remaining muscular part of the diaphragm is derived from the inner surface of the cartilages (as well as in some from a little of the osseous part) of all the ribs which form the margin of the thorax, viz. the five false ribs and the last

from ensiform cartilage ; this is separate.

true one. A narrow muscular slip likewise takes rise from the ensiform cartilage ; and at each side of it there occurs an interval in which no more than loose connective tissue is interposed between the abdomen and thorax, or rather between the proper lining membranes of those cavities. The extensive part of the muscle derived from the ribs commences by a serrated margin, and its angular processes are adapted to the transversalis muscle, whose edge is disposed in a corresponding manner.

Various lengths of fibres.

The muscular fibres proceeding from the several sources now reviewed have various lengths : those situate at the posterior and lateral part of the thorax are the longest, those

* They appear to have been first clearly described by Senac, "Mém. sur le Diaphragme," in "Histoire de l'Acad. Royale des Sciences," 1729, p. 118.

in front are much the shortest. They all curve upwards and inwards to join the central tendon.

The *central tendon* (cordiform tendon; phrenic centre; tendo diaphragmatis; centrum nerveum) is a thin tendinous lamina or aponeurosis, and is the highest part of the diaphragm. Elongated from side to side, and curved on itself at its circumference, the concavity of the curve being directed back towards the vertebral column, it consists of three pieces [5],[6],[7], partly separated from each other by indentations. The right part is the largest; and the left portion, which is elongated and narrow, is the smallest of the three.* From being partially tripartite, the whole has been likened to a trefoil leaf, and each part has been named an "ala." The tendon is insulated by the muscular portion of the diaphragm, with which it is intimately connected—the fibres of the one being directly continued into those of the other. The tendinous fibres cross one another, and are interwoven at various points and in various directions, and thus the strength of this structure is assured.

Central tendon.

Three parts (alæ) partially separated.

Fibres crossed.

Foramina of the diaphragm.—There are three large perforations for the passage respectively of the aorta, the œsophagus, and the vena cava, besides some holes or fissures which are smaller and less regular.—*a*. The foramen for the aorta (hiatus aorticus) is almost altogether behind the diaphragm, for no more than a few of the tendinous fibres of the crura are posterior to the vessel. It is lower than any of the other openings, and is placed in the middle line immediately in front of the bodies of the vertebræ. The circumference is tendinous, being formed by the tendinous appendices of the crura and the curved band which connects them in front. Besides the aorta, this opening transmits the thoracic duct, and generally the vena azygos.—*b*. The foramen for the œsophagus,[12] higher, and at the same time anterior, as well as a little to the left of the preceding, is separated from that opening by the decussating fibres of the crura. It is oval in form, and muscular in structure; but in some cases a small

Foramina.

Foramen for aorta;

the lowest;

is tendinous.

That for œsophagus is muscular.

* The central part is commonly described as the longest. Professor Theile gives the following measurements of the three parts:—Right part three inches broad, and two inches long; left portion three to three and a half inches broad, and one to one and a half inch long. Forepart four to four and a half inches broad, two and a half to three inches long. But the measurement of the central one extends from the point to the notch at the hinder border of the tendon,—a circumstance that might explain its great length. Sömmering, Vom Baue des Menschlichen Körpers.

part, the anterior margin, will be found to be tendinous, being formed by the margin of the central tendon.—*c.* The opening for the vena cava[8] (foramen quadratum) is placed in the highest part of the diaphragm, in the tendinous centre at the commencement of the right ala, or between this and the middle one. Its form is somewhat quadrangular; and it is bounded by bundles of tendinous fibres running parallel with the sides.

For vena cava, the highest, is square and tendinous.

Other small foramina.

Besides the foregoing large foramina, there are small perforations through the crura for the sympathetic and splanchnic nerves on both sides, and for the vena azygos minor on the left side. Moreover, the larger azygos vein often takes its course through the right crus.

Upper surface convex; parts adjacent.

Height.

The upper or thoracic surface of the diaphragm is more arched at the sides than in the centre, and rises higher on the right than on the left side, viz., in the former position in the dead body to the level of the fifth rib at the sternum, and in the latter, as high as the junction of the sixth rib with the breast bone. It is covered by the pleura and the pericardium, the fibrous layer of the latter membrane blending with the tendinous centre. And, in as much as the lateral and posterior parts of the muscle ascend very obliquely from their connection with the lower margin of the thorax, a considerable extent of the upper surface (in the situations mentioned) is close to the ribs, and is separated from them only by a thin portion of lung. The lower surface concave is lined by the peritoneum, and has in apposition with it the liver, (which is bound to the diaphragm by folds of the peritoneum,) the stomach, the pancreas and spleen, and the kidneys.

Lower surface concave.

Different modes of considering the diaphragm.

The diaphragm has received much of the attention of anatomists at all times, and their descriptions often contain expressions of their admiration of its structure and general disposition. These may be represented by the words of Spigelius, "Musculus unus omnium famâ celeberrimus;" or by those of Haller, whose account of the muscle begins thus, "Nobilissimi, post cor, musculi historiam ultimo loco recensemus, ut eam pro dignitate aliquanto fusius exponere liceat."—The diaphragm has been described as a digastric muscle; one end of the fibres being represented to be on the vertebræ, the other end on the ribs, and the tendon interrupting them in the middle.*—It was likewise considered to be a double muscle,† and one part was named superior, the other inferior; the central tendon being the demarcation between the two. The inferior part, that which is connected with the

* N. Stenonis, "de musc. et gland. observ. specimen," p. 8.
† Casp. Bartholini, "Diaphragmatis structura nova," p. 19.

lumbar vertebræ, was known as the "musculus inferior v. minor;" and in some modern books it is mentioned as the lumbar part—"pars lumbalis."

The part of the muscle above the last rib, which has been mentioned as often consisting of thin and scattered fibres, will in some cases be found to be to some extent fibrous rather than muscular in structure. The small band from the ensiform cartilage is sometimes altogether wanting. Peculiarities.

Actions.—When the fibres of the diaphragm contract, the muscle descends and becomes an inclined plane, whose direction is downwards and forwards. By these means the abdominal viscera are pressed against the lower and fore part of the parietes of the cavity, and the capacity also of the abdomen is diminished in proportion as the thorax is enlarged. Should the abdominal muscles and the diaphragm be both brought into action together, the viscera will be compressed between them, and forced towards the lower part of the cavity, as occurs in the expulsive efforts of accouchment, &c. Action of the diaphragm.

After a complete expiration, the upper surface of the diaphragm is on a level with the upper border of the fourth rib at the sternum, on the right side, and a rib lower on the left. After a forcible inspiration, a line from the ensiform cartilage to the tenth rib, would mark the slope of the muscle. Level in forced breathing.

PERINÆAL REGION.

The account of the muscles of this region will most conveniently accompany the description of the other parts of the perinæum, with which they are connected.

MUSCLES OF THE INFERIOR EXTREMITY.

ILIAC REGION.

In the iliac fossa, and along the upper border of the pelvis, the iliacus and psoas muscles are placed. Any particular directions for their dissection are unnecessary, as it is never undertaken until the abdominal muscles have been examined and the viscera removed, and then they are readily brought into view, being merely concealed by the fascia iliaca. Their position.

The *psoas magnus* (figs. 126,[3]; 129,[1]) (lumbalis prælumbo-trochantineus;—ψoα, the loins) is situate along the sides of the lumbar vertebræ, the margin of the pelvis, and Psoas magnus reaches from last

dorsal vertebra to femur. the superior part of the thigh, extending from the last dorsal vertebra to the small trochanter of the femur. It is

Is fusiform. thick and round at the centre, and gradually diminishes in size towards the extremities. The muscle *arises* from the sides of the bodies of the last dorsal and all the lumbar vertebræ, with the interposed fibro-cartilages, also from the anterior surface and lower margin of the transverse processes (parapophyses) of the last-named vertebræ near the base. With the bodies of the bones the connection is effected by means of five distinct parts, which are each attached to the upper and lower margins of two vertebræ and the interposed fibro-cartilage;—the highest to the neighbouring margins of the last dorsal vertebra and the first lumbar, and the lowest to the edges of the fourth and fifth lumbar vertebræ with the inter-vertebral substance. These attachments are connected by thin tendinous arches, extending over the middle of the bones and covering the lumbar vessels and some nerves, which give origin to other fibres. From these several attachments the muscle passes across the brim of the pelvis, beneath Poupart's ligament, and ends in a tendon which is *inserted* into the small trochanter of the femur. The tendon is lodged at first in the substance of the muscle, and begins to receive the muscular fibres near the upper part: at a lower point it lies along the outer side of the psoas, between this and the iliacus, and receives the fibres of both muscles.

Origin from lumbar vertebræ.

Attachment to bodies;

separate with intervening arches.

Insertion.

The tendon common to iliacus.

The muscles of opposite sides diverge from one another in proceeding downwards, and at the lower end each is directed backwards to reach its destination.

Parts behind psoas.

The posterior surface of the psoas muscle corresponds above with the transverse processes of the lumbar vertebræ, the lumbar plexus of nerves, and the quadratus lumborum muscle, from which last it is separated by the anterior lamina of the fascia lumborum; towards the lower end it rests against the hip bone and the capsular ligament of the hip-joint, a synovial membrane being interposed; in the middle this surface overlays a portion of the pelvic cavity, and the muscles of both sides therefore limit the extent of the inlet to the cavity in the transverse direction. The anterior surface, placed behind the peritoneum, is in contact successively with the diaphragm and the inner arched ligament, with the kidney and the renal vessels, the ureter, and the spermatic vessels. This surface is covered by the iliac fascia, and supports inferiorly the femoral artery. The

Separated from hip-joint by bursa.

Narrows inlet to pelvis.

Parts in front.

Is covered with iliac fascia.

inner border is in contact superiorly with the bodies of the vertebræ, and with the sympathetic ganglia resting on these: from the middle of the bones it is separated by the lumbar arteries, and the branches of communication between the spinal and sympathetic nerves, as already stated. In the pelvic region the same border is in contact with the iliac artery; and in the thigh, with the pectineus muscle, from which it is kept apart by the internal circumflex artery. Finally, the outer border of the psoas looks towards the iliacus muscle, from which it is separated at first by a slight interval, and then by the anterior crural nerve.

Connections of the inner border.

Anterior crural nerve between psoas and iliacus.

The upper extremity of the muscle is occasionally connected with the head of the last rib, or with the upper margin of the first lumbar vertebra only. The connection with the transverse process of that vertebra is sometimes wanting. A portion of the fibres derived from the transverse processes may be found to be distinct from the rest of the muscle in its whole course.—(Albinus and Meckel.)

Peculiarities.

Iliacus (fig. 125,[3]) (iliacus internus,—Spigel. and Alb.; ilio-trochantineus).—This muscle is situate in the iliac fossa which it fills, and at the upper and fore part of the thigh. Expanded in the former, and narrowing in the latter situation, it is somewhat triangular in shape. It *arises* from the iliac fossa of the innominate bone, as well as the anterior border (the vertical part), including the two spinous processes: fibres are likewise derived from the base of the sacrum, from the ilio-lumbar ligament, and from the capsule of the hip-joint. From these different sources the fibres pass down: and the greater number inclining obliquely inwards terminate in the side of the tendon common to this muscle and the psoas magnus; some of them are prolonged to a special triangular impression on the upper part of the femur in front of, and below the small trochanter.

Iliacus.

Origin.

Fibres join tendon of psoas;

some reach the femur.

The iliacus rests on the innominate bone and the capsular ligament of the hip-joint, a synovial membrane separating it to some extent from this last, and the margin of the bone. It is subjacent to the iliac fascia and the fascia lata of the thigh; and to its inner side is the psoas muscle, the anterior crural nerve being interposed. In the abdomen the viscera of the iliac region are before the muscle, and some small nerves pass across it.—The psoas and iliacus, with the fascia which covers them, fill up completely the interval between Poupart's ligament and the margin of the hip-bone, from the ilio-pectineal eminence outwards.

Covers hip-joint—synovial bursa between.

Psoas and iliacus fill up space under crural arch.

Peculiarities.

This muscle is often still named iliacus internus, though there is now no correlative term in use, no muscle being called iliacus externus. Several of the older anatomists called the pyriformis by that name. Some of the external fibres of the iliacus, those derived from the anterior inferior iliac spine close to the rectus femoris, are from time to time found separated from the rest, even from their origin to the termination on the femur below the small trochanter.—The psoas and iliacus are so completely united by their common tendon that they might be regarded as a single muscle. They have been so considered by several anatomists.

Psoas parvus. Origin. Lies on larger psoas. Is connected with iliac fascia.

Psoas parvus (fig. 129,[2]) (præ-lumbo-pubius).—This long and slender muscle is placed along the front of the psoas magnus. It *arises* from the bodies of the last dorsal and first lumbar vertebræ, with the fibro-cartilage between them, and soon ends in a flat tendon, which passes along the front and the inner side of the psoas magnus, to be *inserted* into the ilio-pectineal eminence and the brim of the pelvis. The muscle is covered at its origin by the diaphragm, and rests in its whole length on the psoas magnus. Its tendon is united with the fascia iliaca, and may exercise some influence on the tension of that membrane.

Usually absent. Variations of origin.

The psoas parvus is most frequently absent. It was present in no more than one out of twenty bodies which M. Theile * examined with special reference to its existence. When present, it is liable to many changes in the place of origin; thus, it may be connected only with the first lumbar vertebra, or with the second and the fibro-cartilage above it, and it has been observed to commence by two parts or heads separated by an interval.

Flexors of hip joint act on the limbs,

Combined Actions.—The psoas and iliacus, when they take their fixed point above, can bend the thigh on the pelvis, and rotate the limb somewhat outwards,—the latter power being derived from the direction of their common tendon and the insertion into the projection of the trochanter minor.

or on the pelvis.

These muscles assist materially in raising the body from the recumbent posture, and in maintaining the erect position of the body; in these cases they take their fixed point at their insertion into the femur, and then act upon the pelvis and spinal column, drawing them forwards so as to raise and keep them erect upon the thighs. If this action be continued, the trunk may be bent forwards as in bowing. It is scarcely necessary to add, that this bending of the body will be directly forwards if the muscles of opposite sides act together, and obliquely to one side if they act separately.

* In Sœmmerring, op. ante citat.

GLUTEAL REGION.

In this space, which corresponds with the posterior and external surface of the pelvis, are the glutei, and the external rotator muscles of the thigh.

Dissection.—The body being placed in the prone position, and the abdomen supported on a high block, the foot should be rotated inwards, and the limb adducted, in order to put the gluteus on the stretch. An incision may be made through the skin, from the coccyx obliquely upwards over the side of the sacrum and the posterior iliac spine as high as the crest; from which point draw another obliquely downwards over the great trochanter. The flap thus included should be dissected cleanly off the muscle in the course of the fibres; that is to say, downwards and outwards. The remainder of the skin which covers the pelvis may be reflected upwards and outwards, the fascia serving as a guide. The tensor vaginæ femoris and part of the gluteus medius will appear, but the rest of the latter can be seen only when the gluteus maximus is detached. To effect this, let its lower border be drawn a little forwards, and the scalpel be inserted beneath it, so as to raise it from the sciatic ligament, and successively from the side of the coccyx, sacrum, and hip-bone, proceeding from below upwards. When the muscle is detached, and turned down on the femur, the external rotators and gluteus medius come into view, and require little further dissection. As the gluteus medius covers the third muscle of that name, the easiest mode of reflecting it is by cutting through its tendinous insertion, and drawing it upwards. The external rotators should be attentively examined, more particularly the two obturator muscles: the internal one cannot be fully seen until the pelvis is divided; but the direction of its two parts, and the peculiar appearance presented by its tendon, where it slides over the border of the innominate bone, can be observed by cutting it across near its insertion, and reflecting it outwards. Dissection of the buttock.

Fig. 127.*

Gluteus maximus (fig. 127,[1]) (gluteus magnus,—Alb.; ilio-sacro-femoralis).—This is a very large Gluteus maximus.

* The superficial muscles of the left thigh on its posterior aspect. 1. Gluteus maximus. 2. Part of Gluteus medius. 3. Vastus externus. 4. Gracilis. 5. Biceps femoris, the long head; and 6. the short head. 7. Semi-tendinosus. 8. Semi-membranosus.

with the special tensor of the fascia lata; and the posterior border is close to the pyriformis, the gluteal artery being interposed.

Gluteus minimus, is fan-shaped. Origin below preceding. Fibres converge. Tendon, its insertion.

The *gluteus minimus* (ilio-trochantereus minor), the third and smallest of the gluteal muscles, is placed under the gluteus medius, which must be removed to bring it into view; and, like that muscle, it is triangular or fan-shaped, the fibres converging from a broad surface of origin on the pelvis to a narrow place of insertion on the femur. It *arises* from all the space on the dorsum ilii between the superior and inferior curved lines.* The fibres approach one another: they descend and terminate on an aponeurotic expansion, which covers the muscle towards its lower end; and that structure narrows into a tendon, which is *inserted* into an impression along the anterior part of the great trochanter.

Parts over and under. Blends with gluteus medius. Synovial bursa.

Between this muscle and the preceding one are the gluteal vessels and nerve; and a small portion is covered by the pyriformis, where it extends farther back than the gluteus medius. The anterior margin blends with the last-named muscle, and the posterior part of the tendon is often joined with that of the pyriformis.—A synovial bursa is interposed between the tendon (its anterior part) and the trochanter.

Action of gluteal muscles, on the thigh;

Actions.—The glutei act alternately on the femur and pelvis, according as the one or the other becomes relatively their fixed point of attachment. All three act as abductors. Moreover, the anterior fibres of the gluteus medius and minimus draw the trochanter forwards, the posterior backwards, giving a slight rotatory motion to the femur. The gluteus maximus is a powerful abductor, and by the direction of its fibres it is calculated to draw the femur backwards, at the same time it rotates the whole limb outwards if this be kept extended.

on the pelvis;

When the thighs become the fixed points, these muscles act on the pelvis. In rising from the sitting or stooping posture the large glutei act forcibly in straightening the hip-joint. In standing, the great glutei draw the pelvis backwards, and maintain it and the trunk in the erect position; in this they are assisted by the semi-tendinosus, semi-membranosus, and biceps of each side, which draw downwards

* See the extent and position of these lines, vol. i. p. 138. As the lower line extends some way along the margin of the sciatic notch, so does the muscle.

the ischial tuberosities, so as to elevate the fore part of the pelvis.

The gluteus medius and minimus are chiefly called into action in progression, and in standing on one leg; they draw the pelvis towards the femur which is fixed, and by this action counterbalance the weight of the trunk, and maintain it erect on the limb. This alternation of action of the muscles of opposite sides during progression, gives to the pelvis that rotatory motion so perceptible in those who walk irregularly, and which is strikingly evident in females, in consequence of the great breadth of the pelvis. In progression.

The *external rotator muscles* form a group by themselves, being placed deeply at the back of the pelvis. They are the pyriformis, two gemelli, two obturators, and quadratus femoris. External rotators.

Dissection.—Most of these are exposed by the removal of the gluteus maximus. The origin of the obturator internus and pyriformis cannot be seen until the pelvis is opened. Dissection.

The *pyriformis* (fig. 128,[2]) (pyramidalis; iliacus externus; sacro-trochantereus) is situate at first within the pelvis, and afterwards behind the hip-joint, extending from the anterior surface of the sacrum through the large sacro-sciatic notch to the great trochanter of the femur; and, as in this course it gradually decreases from a considerable size to a small tendon, the muscle has the shape its name implies. It *arises*, by three fleshy and tendinous digitations, from the second, third, and fourth divisions of the sacrum, interposed as it were between the anterior sacral foramina; a few fibres are also derived from the inner surface of the hip-bone near the hinder curved border (the sacro-sciatic notch), and from the sacro-sciatic ligament. From these attachments the muscle passes out of the pelvis by the great sacro-sciatic notch, becoming gradually narrow and following nearly a horizontal course, and is *inserted* into the upper border of the great trochanter by a rounded tendon, whose fibres are blended with those of the gemelli and obturator internus. Pyriformis, in pelvis and on hip-joint. Origin. Tendon blends at insertion with others.

Within the pelvis the pyriform muscle is placed behind the sacral plexus of nerves, the internal iliac vessels, and the rectum (the last more especially at the left side). Outside the pelvis one surface rests on the innominate bone and the fibrous capsule of the hip-joint, the other is covered by the gluteus maximus. Its upper border is parallel with the Parts adjacent in pelvis and out of that cavity.

gluteus medius, from which it is separated by the gluteal vessels as these emerge from the pelvis; and the lower border is a little above the gemellus superior, the interval being occupied by the sciatic and pudic vessels and nerves.

Synovial bursa.

—A small synovial bursa is interposed between the tendon at its termination and that of the gluteus medius.

Muscle in some cases divided. Sciatic nerve between parts.

—One of the intervals always existing at its points of origin sometimes continues to be apparent even after the muscle has passed out by the pelvis; when this is the case, a part of the great sciatic nerve passes through it.

Obturator internus is placed in pelvis and behind hip-joint.

The *obturator internus* (fig. 128,[5]), (sub-pubio-trochantereus,) like the preceding muscle, is partly lodged within the pelvis (and this is much its largest portion), and partly lies over the posterior surface of the hip-joint. From the anterior wall of the pelvis, which it covers to a large extent, it is directed outwards, and, having escaped from the cavity, turns forwards to the femur, with which it is connected through the medium of a narrow tendon.

Different direction of parts.

The two portions of the muscle have therefore different directions; and the angle between them, or the turning part, is supported by the small sciatic notch at the posterior border of the innominate bone.

Origin.

The internal obturator muscle *arises* from the obturator membrane, and the fibrous arch which protects the obturator vessels and nerve passing by the muscle; slightly from the bone bounding the thyroid aperture anteriorly; but largely from the broad flat pelvic surface of bone behind that aperture, extending downwards to the outlet, backwards as far as the sciatic notch, and upwards to the brim of the pelvis. The fleshy fibres from this extensive surface are received within the pelvis on four or five tendinous bands, and by this arrangement the muscle becomes narrowed before emerging from the cavity.

Tendinous bands rest on sciatic notch. Bursa.

The tendinous bands turn over the small sciatic notch, which is grooved, and covered with cartilage, and lubricated with a synovial bursa. In proceeding forwards, the fibrous processes soon unite into a single tendon; and this, passing horizontally onwards, is inserted, in connection with the gemelli, into the upper border of the great trochanter in front of the pyriformis, and into the contiguous part of the neck of the femur.

In contact with pelvic surface.

In the pelvis this muscle is covered by the pelvic fascia, and is crossed by the internal pudic artery and nerve; and the same surface forms the outer boundary of the ischio-

rectal fossa. The tendon, having the gemelli united to it on the sides, is covered by the gluteus maximus, and is crossed by the great sciatic nerve: it is in contact with the capsule of the hip-joint.—There are usually two synovial bursæ connected with the tendinous part of the muscle. One has been already referred to, as occurring between it and the surface of bone over which it turns. The other, of much smaller size, is elongated and narrow, and is beneath the tendon where this rests against the fibrous capsule of the hip-joint. In some instances the two are continuous with each other, and form but a single sac. Is on capsule of hip-joint. Synovial bursæ.

The obturator muscles were so named, because of closing or covering the thyroid foramen.* The internal muscle was likewise named "Marsupialis, or "Brusalis," from having connected with it a synovial bursa, which is perhaps more than usually distinct. Names.

The *gemelli* (gemini; ischio-trochanterei) are two small narrow fasciculi, consisting chiefly of fleshy fibres extended horizontally at each side of the tendon of the obturator internus; and they are named from their relative position. The superior one (*gemellus superior*, fig. 128,[3]), which is the smaller muscle, *arises* from the ischial spine; the inferior (*gemellus inferior*[4]) takes origin from the upper and back part of the tuberosity of the hip bone. Passing outwards, they join with the tendon of the internal obturator muscle placed between them, in some instances covering and concealing it from view, and are *inserted* with that tendon into the upper margin of the great trochanter of the femur. A part of the fibres ends on the tendon of the obturator, and this is especially the case as regards the superior muscle. Gemelli. Superior; inferior. They join tendon of obturator internus.

One of the gemelli is immediately below the pyriformis; the other is parallel with, and close to the quadratus femoris, and at its termination is in contact with the tendon of the obturator externus muscle. With other parts they have the same immediate connections as the tendon of the obturator internus which they enclose. They partly cover the synovial bursæ connected with that muscle. Parts adjacent.

The gemelli might well be considered with the older anatomists† Gemelli but appendages to obturator internus.

* "Propterea quod foramen ossium pubis principiis suis obturent." Spigelius, "De h. corp. fabr." lib. iv. cap. 22.

† *e. g.* Vesalius, "Oper." p. 414.

as appendages to the obturator, with which they are blended. From their connection with its synovial bursa they were regarded by some authors as the muscular "marsupium" of that muscle.*—The gemellus superior is often very small, and in some cases is altogether absent.

Quadratus femoris below preceding.

The *quadratus femoris* (tuber-ischio-trochantereus) (fig. 128,[6]) succeeds immediately to the muscles last described, intervening between them and the adductor magnus, and extending from the ischial tuberosity to the upper part of the femur. It is short, flat, and square in shape; and from this last circumstance its name is taken.

Origin.

Insertion.

The fibres *arise* from the external curved border of the tuber ischii, and proceeding horizontally outwards, are *inserted* into the greater part of the linea quadrati at the back of the femur,† above the adductor magnus.

Parts over and under.

This muscular plane has an admixture of tendinous fibres at its attachments. It is covered by the same parts as the muscles immediately above it, and likewise, to a small extent, by the top of the semi-membranous muscle; between it and the small trochanter is a bursa. On removing it, the outer part of the obturator externus is brought into view.

Obturator externus.

Deep position.

The *obturator externus* (sub-pubio-trochantereus externus) (fig. 128,[7]) is triangular in shape, and is placed very deeply, extending horizontally from the anterior surface of the pelvis to the trochanteric fossa of the femur, which it reaches by passing behind the hip-joint. To lay bare its origin requires the removal of the muscles placed in front, and to the inner side of the thyroid foramen, viz. the psoas, iliacus, pectineus, adductor longus, and brevis; and the tendon is shown by the removal of the gluteus maximus and quadratus femoris.

Origin.

The muscle *arises* from the anterior two-thirds of the outer surface of the obturator membrane; and from the bone bounding internally the thyroid foramen, this attachment being widest opposite the symphysis pubis. From this extensive origin the fibres pass outwards, converging to a

* Among others, Spigelius, loc. cit.; Cowper, "Myot. Reform." § 155.

† This ridge, which may be so named from the attachment of the quadratus muscle to it, is about two inches and a-half long, and descends vertically at the posterior aspect of the upper end of the femur, beginning above at the tubercle on the posterior intertrochanteric ridge, and ending below in the line leading to the outer trochanter.

tendon which is directed behind the neck of the femur, to be *inserted* into the trochanteric fossa below the other rotator muscles.—The immediate connections of the obturator externus with other muscles are sufficiently stated above. Part of the obturator nerve pierces the fleshy fibres. Insertion.

Actions.—The transverse direction of these muscles, and their mode of insertion into the trochanter, together with the great mechanical advantage afforded them by the length of the cervix femoris, enable them to act powerfully in rotating the thigh, and therefore the whole limb outwards, when the femur hangs vertically. In position, direction, and action, they are analogous to the muscles which pass from the dorsum of the scapula to the great tuberosity of the humerus. In the upper limb, however, the external rotators are nearly equalled in strength by their antagonist, the subscapularis; but in the lower limb the corresponding muscles are very feebly opposed by the tensor vaginæ femoris, and the anterior fibres of the gluteus medius, which alone act directly in rotating the limb inwards, if the semi-membranosus be excepted, which may under some circumstances co-operate in this action. Action of external rotators powerful. Internal rotators, feeble.

If the femur be bent on the pelvis, the line of direction of these muscles nearly coincides with the axis of the bone; their power of rotation then ceases, and they become abductors, with the exception of the obturator externus, which can still rotate outwards. Action of rotators changed by flexion of limb.

When the femur is fixed, as in standing on one leg, they can turn the face to the opposite side; and when both limbs are immoveable, the pyriformis and the obturators serve specially to balance the trunk, and to erect the same if it has been inclined backwards. Use when the femur is fixed.

ANTERIOR FEMORAL REGION.

At the fore part of the thigh, immediately beneath the skin and fascia, are these muscles, viz., the tensor vaginæ femoris, sartorius, rectus, vastus externus, and vastus internus and crureus.

Dissection.—To lay bare the fascia lata:—In the first place let the knee be slightly bent,—the limb being rotated outwards and supported on a block. And as in this position the course of the femoral artery is indicated by a line extended from midway between the anterior superior iliac spine and the pubic symphysis to the inner condyle of the femur, the first incision through the skin should be made to the edge of the patella, Dissection of the fascia lata.

and in the same direction. In order to reflect the integuments with facility, a second incision may be made transversely at the junction of the upper with the middle third of the thigh; and, finally, another in the same direction at the junction of the middle with the lower third: this marks the termination of the femoral artery. The flaps of skin thus formed are to be dissected back, so as to expose the fascia lata. This membranous investment should be attentively examined in its entire extent, particularly at the upper part; the differences of texture and thickness which it presents in different spots should also be carefully noted.

Of the muscles.

To see the muscles:—In prosecuting the dissection, so that the muscles on the fore part of the thigh may be examined (and it is with these the dissection usually commences), nothing more is necessary, after the skin has been removed, than to pinch up the fascia with the blades of the forceps, divide it with the scalpel, and reflect it from above downwards, in the direction of the fibres of each muscle. After the sartorius and rectus have been dissected in their entire length, and their attachments and relations attentively examined, the former may be cut across in the middle, and the parts drawn aside; the latter, too, may be divided near its origin, and turned down on the leg. The large extensor is thus brought fully into view, so that its three parts (the two vasti and the crureus) may be inspected successively, at the same time as it is considered as a whole. The muscle, in fact, may be compared to a hollow splint, encasing the anterior and lateral surfaces of the shaft of the femur, leaving unoccupied only the linea aspera and its bifurcations (superior and inferior).

How to bring into view the adductors.

To detach the vasti:—Before the extensors are detached and reflected, the form and boundaries of the opening for the femoral vessels should be attentively examined, as the vastus internus constitutes a part of it; nor should the fascia be omitted which passes from the latter muscle to the adductors, covering the vessels. A perpendicular incision may, in the next place, be made through the muscle, extending from the one extremity to the other over the middle of the femur. If the margins of the incision be drawn aside, a clear view will be obtained of the manner in which the fibres pass to be implanted, by so many separate points, into the surface of the bone. Holding the border of the cut surface tense, and with the blade of the scalpel placed in the horizontal position, the muscle may be detached from the bone inwards as far as the insertion of the adductors, and outwards to the attachment of the gluteus maximus and the short head of the biceps, so as to denude the front and sides of the thigh-bone. Having proceeded so far, cut from within outwards through the vasti, so as to detach them altogether. When this is done, the two parts thus separated may be turned down on the leg, but still left connected with the patella. By these measures the inferior attachments of the next set of muscles (adductors), which would otherwise lie in a great degree concealed, will be brought into view.

Tensor vaginæ femoris.

The *tensor vaginæ femoris*,—Alb. (musculus fasciæ latæ; membranosus; ilio-aponeurosi-femoralis) (fig. 129,[5]) is situate at the upper and outer part of the thigh, extending obliquely downwards and backwards from the anterior superior iliac spinous process for a short space below the

great trochanter. The muscle is elongated and flat, and is broader at the lower than at the upper extremity. It *arises* by aponeurotic fibres from the external surface of the fore part of the iliac crest, and from part of the notch between the two anterior iliac spines, as low as the attachment of the sartorius; and terminates about three inches below the great trochanter of the femur, its fleshy fibres being received between two laminæ of the fascia lata, into which they are thus inserted.—The external surface of the muscle is covered by a layer of the fascia lata; the internal one is separated by another process of the same membrane from the rectus femoris and the vastus externus. Its anterior border is at first close to the sartorius; but lower down it diverges, and leaves an angular interval occupied by the rectus femoris. The posterior border is for some way applied to the gluteus medius, and is connected with it at its origin; but lower down these muscles are separated by an interval.

Attachments.

Parts adjoining.

Fig. 129.*

Actions.—As its name imports, the direct action of this muscle is to render the fascia tense, and thereby assist the other muscles. If this effort be farther continued, the obliquity of its direction will enable it to rotate the whole limb inwards, provided the other muscles remain quiescent. In the erect position, by taking its fixed point below, it will act in balancing the pelvis.

Its use.

Sartorius (fig. 129,[6]) (ilio-prætibialis).—This flat, narrow muscle extends from the outer side of the pelvis to the inner

Sartorius.

Fibres longer than those of any other muscle.

* The muscles of the fore part of the thigh, as seen after removal of the integuments and the fascia lata. 1. Psoas magnus (its lower part). 2. Tendon of psoas parvus. 3. Part of iliacus. 4. Gluteus medius. 5. Tensor fasciæ latæ. 6. Sartorius. 7. Rectus femoris. 8. Vastus externus. 9. Vastus internus. 10. Gracilis. 11. Pectineus. 12. Adductor longus. 13. A small portion of adductor magnus.

and fore part of the tibia, and its fibres are longer than those of any other muscle in the body. It *arises* by tendinous fibres from about half of the grooved anterior margin of the hip-bone between the anterior superior and inferior iliac spinous processes, and from the former point of bone; and is *inserted*, by an expanded aponeurosis, into the upper and inner side of the tibia, opposite and near to the tubercle, and extending about an inch below it. In this long course the muscle is directed over the anterior part of the thigh, obliquely inwards in the upper third, then vertically at the inner aspect of the limb as far as the knee, and below this it turns obliquely forwards to its place of attachment. The tendon of insertion, broad and expanded, covers those of the gracilis and semi-tendinosus (a synovial bursa being interposed), and sends off one expansion which strengthens the capsule of the knee-joint by becoming identified with it, and another that blends with the fascia of the leg.

Changes of direction.

Tendon covers those of semi-tendinosus and gracilis.

Parts adjacent.

The sartorius is covered only by the fascia lata and the integument. It covers the iliacus and rectus femoris muscles; the femoral vessels; the adductor longus, adductor magnus, vastus internus, gracilis, and semi-tendinosus muscles. Its internal border and the adductor longus form the sides, and Poupart's ligament the base of a triangular space in the upper third of the thigh, through the centre of which the femoral artery passes.

Name of muscle.

The name of this muscle has been taken from the influence ascribed to it on the position of the limb peculiar to tailors. It appears to have been first introduced by Spigelius.*

Direction varies.

As the direction the sartorius takes inwards varies in different cases, the position at which it covers the femoral artery (the most important practical point in the anatomy of the muscle) is by no means constant. In some bodies it crosses inwards so speedily as to be placed over the vessel at a comparatively short distance from Poupart's ligament.†

Quadriceps.

Quadriceps extensor cruris (Sœmmerring),—The mass of the extensor muscles of the leg, which is distinguished by this general name, is of very large size, and covers the whole of the anterior and lateral surfaces of the thigh-bone.

* "Quem ego *Sartorium musculum* vocare soleo, quòd sartores eo maximè utantur, dum crus cruri inter consuendum imponunt."—Spigelius, "De h. Corp. fabr." 1, 4, c. 23.—Riolanus named the muscle "*longus* sive *sutorius*."

† This point is illustrated in the work on Arteries before quoted, plate 74. figure 4.

It is connected with the tibia by tendinous structure, which is undivided and common to the whole mass; but the upper extremity is separated into parts or heads, which are more or less distinct from each other. One of the heads has no attachment to the femur; it reaches from the hip-bone to join with the other parts of the muscle near the patella, having a straight course between these points over the fore part of the thigh; and hence it is named "rectus femoris." The other pieces of the quadriceps are in immediate connection with the femur, covering it from the trochanters to the condyles, except at the linea aspera, and at the intervals between the lines which extend from this towards the upper and lower ends of the bone. The portion laid on the outer side of the bone is named "vastus externus;" that on the inner side, "vastus internus;" these names being derived from the large number of the muscular fibres and the position they occupy. Another part placed on the anterior surface of the femur has been named "crureus:" this last is really not separable from the vastus internus.

Is undivided at lower end, but upper part is divided. One part not connected with femur. Others cover great portion of that bone. Parts;—position and name of each.

a.—The *rectus femoris* (ilio-rotuleus,—Cowper) (fig. 129,[7]) is situate in front of the thigh, and is extended in a straight line from the pelvis to the patella—whence the name. It *arises* by two tendons,—one of which embraces the anterior inferior iliac spinous process; the other, about one inch and a half long, the "reflected" tendon, turns outwards, and is attached to the groove above the brim of the acetabulum. The tendons unite at an angle, and then spread out into an aponeurosis from which fibres arise. The muscle gradually increases in breadth and thickness towards its middle, from which it again diminishes towards its lower part; the fleshy fibres ending in another tendinous expansion, which gradually narrows, and is *inserted* into the tibia in conjunction with the other parts of the extensor. The muscle tapers from the middle to both ends; and the fibres are disposed in two sets, united at acute angles along the middle line: from this arrangement, which resembles that of the lateral fibrils of a quill or feather, the muscle is said to be penniform. The fibres of the upper tendon run down a considerable way on the fore part of the muscle; those of the lower tendon are prolonged upon the posterior surface.

Rectus femoris. Origin (two tendons). Joins other parts of quadriceps.

The anterior surface of the rectus is covered in all its extent by the fascia lata, except a small portion superiorly, where it is overlaid by the tensor vaginæ femoris, iliacus,

Structures over and under the muscle.

and sartorius muscles: the reflected tendon is covered by the gluteus minimus. By the posterior surface the muscle is in contact with the vessels and nerves, and with the vastus externus and crureus.

Vastus externus. Origin.

b.—*Vastus externus* (venter externus,—Sœmmerring.)—This is the largest part of the muscle. It *arises* by an extensive aponeurosis, which is attached to the base of the great trochanter at the anterior aspect, (beginning in front at a tubercle), and to a well-marked ridge on the outer side; likewise to the line extended between the trochanter and the linea aspera, as well as to the linea aspera itself (the outer margin): the aponeurosis spreads over the surface, and gives origin to a very large number of muscular fibres. To these are added others, which spring from the intermuscular fibrous layer attached to the line of the femur between the linea aspera and the external condyle. The whole terminate in a large tendinous expansion, which is laid on the deeper surface of the muscle towards its lower end: this tendinous structure becoming narrowed is fixed to the patella, and joins with the other parts of the general extensor muscle. The fibres vary in direction,—the highest are perpendicular, the lowest nearly horizontal, and the rest gradually pass from one of those directions to another.

Ending.

Structures over and under the muscle.

The vastus externus is covered to a small extent by the rectus, and the special tensor of the fascia lata; and the rest of it lies immediately beneath that investing membrane—the thickest (external) part. The muscle conceals in part the crureus; and some large branches of the external circumflex artery are beneath it.

Vastus internus and crureus are not separable.

c.d.—*Vastus internus* and *crureus* (venter internus and venter posterior,—Sœmmerring).—There is no real separation between the parts which are distinguished by these names. Their position on the bone and the disposition of the tendon at the lower end alone serve to make the distinction.—The *vastus internus*, which occupies the inner aspect of the femur, increases considerably in thickness towards the lower end. It *arises* by aponeurotic fibres from the line running downwards, at some distance before the small trochanter, from the anterior intertrochanteric ridge to the inner line diverging from the linea aspera of the femur; from the lower half of that inner line, and from the inner lip of the linea aspera; and from the fibrous partition attached to the line extended between the linea aspera and the inner condyle in connection with the tendon of the adductor

Vastus internus.

Origin.

magnus. From this extensive line of origin, and likewise from the inner surface of the bone, the fibres proceed downwards and outwards in directions necessarily varying, and are received on the tendon of insertion, which is for the most part on the deep surface of the muscle. The tendon terminates by joining with the like structures from the other divisions of the extensor muscle in the neighbourhood of the patella.—The *cruræus* (seu femoreus,—Cowper).—To this head is assigned the muscular structure arising on the anterior and outer surfaces of the femur, reaching from the line between the trochanters to within a couple of inches of the patella, and outwards to the vastus externus. The tendon in which the fibres terminate inferiorly is laid on their anterior surface, and has, therefore, a different position with respect to the muscular substance from the tendon in which the vastus internus ends.

Tendon of insertion.

Cruræus.

Lower tendon.

The vastus internus is covered by the fascia lata and the sartorius, and is in contact at its inner side with the femoral vessels. The inner border is connected with the tendons of the adductor muscles. The cruræal part is covered by the rectus muscle, and partly by the vastus externus. Its lower end lies on the synovial membrane of the knee-joint.

Parts adjacent.

Subcruræus.—Under this name is described a small band of muscular fibres, which extends from the anterior surface of the femur to the upper part of the synovial membrane of the knee-joint, on which it ends in scattered fibres. This little muscle is placed beneath the cruræal portion (hence the name applied to it,) and in some cases it is united with that muscular mass. It is not unfrequently double, or consists of two separate bundles.

Subcruræus.

Connected with synovial membrane of knee.

The *tendons of insertion* of the different parts of the great extensor muscle above described are joined together at the lower end of the thigh (constituting the whole a single muscle,) and are continued downwards to be fixed to the anterior tubercle of the tibia, and an inch of the bone below it. The patella is contained in the tendon; and the part of the tendinous structure below that bone, consisting of thick longitudinal fibres, is named the ligament of the patella (see vol. i., p. 226). Moreover, an aponeurotic layer is extended at the sides of the patella from the vasti to the upper extremities of the tibia and fibula. The fibrous structure on the outer side is strengthened by, and for the most part is derived from the fascia lata, which is very resistent

Tendon of quadriceps.

Patella in tendon.

Ligament of patella.

in that situation. The tendinous expansion covers the knee-joint.

Meaning of triceps extensor.

By most French anatomists the vasti and crureus are described apart from the rectus as a three-headed muscle, and the name "triceps crural" is applied to the mass (see Sabatier, Gavard, Boyer, &c.): though that name had been assigned to the adductors by several anatomical writers, and even by one eminent authority in France (Winslow).

Ordinary action of the extensor muscles.

Actions.—The most ordinary action of the foregoing muscles is to extend the leg upon the thigh, which they are enabled to do by their connection with the patella and its ligament, the latter being inserted into the tibia.

When the leg is fixed.

If the leg be fixed, as in the standing posture, the extensor muscles, taking their fixed point below, will act upon the femur and keep it perpendicularly on the condyles of the tibia, so as to counteract the influence of the weight of the body, which tends to flex the knee as well as the other articulations. The rectus and sartorius assist materially in bending forwards the trunk, and in maintaining the erect position of the body, as for instance, when we stand on both legs; for they act on the pelvis drawing it forwards, and keeping it fixed and upright on the femur: in this way they become assistants to the psoas and iliacus. It may be observed that the oblique direction of the sartorius enables it to give a slight rotatory motion to the pelvis when we stand on one leg, by drawing the spinous process downwards and inwards, and turning it to the opposite side.

Use of the sartorius.

The sartorius flexes the hip and knee-joints, and makes tense the fascia lata as in squatting; and when the leg is free to move, it may become either a flexor or an extensor of the knee-joint, according to the position of the bones of the leg to the end of the femur.

INTERNAL FEMORAL REGION.

Along the inside of the thigh the following muscles are placed, viz. the gracilis, pectineus, adductor longus, adductor brevis and magnus. The pectineus at its origin is rather at the fore part of the limb, but at its insertion it lies to the inner side.

[illegible]

Dissection.—To see the muscles of this group, nothing more is required, after examining the extensor muscles, than to remove the fascia from the inner and fore part of the thigh. The direction and attachments of the adductor longus, running obliquely from the angle of the

pubes to the middle of the thigh, are at once obvious. The gracilis, too, will be observed running along the inner border. If the thigh be abducted, the fibres of these muscles will be rendered tense, and their dissection facilitated.

When proceeding with the dissection, the adductor longus may be severed from its upper attachment, and drawn downwards on the femur. In doing this, its posterior surface will be observed to be connected to the adductor magnus for a little way before their fibres reach the bone. The pectineus, lying to the outer side of the adductor, may in the next place be examined, and reflected after the same manner, and the adductor brevis and the obturator externus will then be brought into view. **How the muscles are to be cut.**

Whilst these measures are being executed, both surfaces of each muscle should be dissected, or, in other words, all the loose tissue connected with them should be removed by successive strokes of the knife, the edge being carried in the course of the fibres; and when their attachments, external conformation, and structure have been thus fully made out, each of them may be again restored to its place, that their mutual relations and bearings may be reconsidered. It is usual to direct that muscles, more especially long ones, should be divided in the centre, and the two portions reflected; but the student should examine with great accuracy the points of attachment of muscles, for without a precise knowledge of these it is quite impossible to reason correctly on the actions and uses. When a student is performing the dissection of the limb for the first time, it may be well if he confine his attention chiefly to the muscles and the large vessels and nerves, observing merely the general outline of their branches. **Directions to the student.**

The *gracilis* (fig. 129,[10]; fig. 127,[4]) (pubio-præ-tibialis) is situate along the inner side of the thigh, extending from the pubic part of the hip bone to the upper end of the tibia. The muscle is flat and thin; two to three inches in depth at the upper extremity, narrow and tapering at the lower. It *arises* by a thin aponeurosis from the pubes, close to the symphysis (the lower half in depth), also from the upper part of the pubic arch (pubic ramus); and is *inserted* by a tendon, which is at first round but afterwards becomes flat and half an inch wide, into the inner side of the tibia, on the same plane with, but higher than the semi-tendinosus, and under the expanded tendon of the sartorius. The direction of the muscle is vertical, but at the lower extremity it inclines forwards to the point of attachment. **Gracilis.** **Origin.** **Inserted under sartorius.**

The inner surface of this slender muscle is covered by the fascia lata, except a small part inferiorly, where it is overlapped by the sartorius; the external surface rests against the adductor longus, adductor magnus, and semi-membranosus, and the knee-joint with the internal lateral ligament. A bursa separates it from this ligament. **Is close to fascia, except tendon.**

The *pectineus* (fig. 129,[11]) (pectinalis,—Douglas; pubio- **Pectineus.**

femoralis) lies at the upper and fore part of the thigh, and is extended from the upper surface of the pubes to the posterior and inner aspect of the femur. Flat and nearly quadrangular in form, it *arises* from the pectineal line, and from the surface of bone in front of it, between the eminence of the same name and the pubic spine; about two inches in width below, it is *inserted* into the femur behind the small trochanter, and into the upper part of the line which connects the linea aspera of the femur with that prominence. In its course downwards, the muscle inclines backwards, and opposite the smaller trochanter turns on itself, so that the anterior surface looks somewhat outwards. It consists of fleshy fibres, except at the attachments; the lower of these is aponeurotic, and the upper one slightly so.

(Origin. Insertion.)

Parts adjacent. The pectineus is in contact, by the anterior surface, with the fascia lata and the femoral vessels; by the posterior surface, with the obturator vessels and nerve, and the external obturator and adductor brevis muscles. By the outer border it reaches the psoas magnus; by the inner border, the adductor longus.

Adductor longus. The *adductor longus* (fig. 129,[12]) (adductor primus; pubio-femoralis), situate on the same plane as the preceding muscle, is flat, irregularly triangular, and extends obliquely from the anterior and upper part of the pubes to the linea aspera of the femur. It *arises* by a tendon from the fore part of the pubes, at the angle formed by the junction of the crest with the symphysis; and is *inserted* into the inner margin of all the linea aspera, between the vastus internus and the adductor magnus. Between these points it is directed downwards, with an inclination outwards and backwards; and the fleshy fibres commencing by a tendon end, inferiorly, in an aponeurosis which unites by a few fibres with that of the adductor magnus.

(Origin. Insertion.)

The muscle is covered by the fascia lata, the sartorius, and femoral vessels; the posterior surface rests on the two other adductor muscles. The external border is parallel with the pectineus (a small portion of the adductor brevis being observable behind and between them); the inner border, which is much the longer, is in apposition with the gracilis.

The *adductor brevis* (adductor secundus: sub-pubio femoralis) lies behind the two preceding muscles. In form it is nearly triangular, being thick and narrow at the upper part,

but gradually becoming broader and thinner towards the insertion. It *arises* by a narrow origin, about two inches deep and joined with that of the gracilis, from the external surface, and the descending ramus of the pubes; directed obliquely backwards and outwards it is *inserted* (by a tendon) into the whole of the oblique line leading from the smaller trochanter of the femur to the linea aspera, immediately behind the insertion of the pectineus. Origin. Insertion.

The short adductor is in contact, by the anterior surface, with the pectineus and adductor longus; by the posterior, with the adductor magnus; by the external border, with the obturator externus, and the conjoined psoas and iliacus; by the inner border, with the gracilis in part of its extent, and with the adductor longus. It is pierced by some of the perforating branches of the profunda artery. Adjacent parts.

Adductor magnus (ischio-femoralis). — This very large muscle is placed deeply at the posterior and inner part of the thigh,—therefore but a few of its fibres [13] can be seen in this view; and it extends from the ischial tuberosity and the arch of the pubes to nearly the whole length of the femur, and to the inner condyle of that bone. It *arises* from all the lower border of the hip-bone entering into the construction of the pubic arch; viz., from the symphysis pubis to the lower part of the ischial tuberosity. The muscular fibres diverge from their origin, somewhat like the ribs of a fan from their central pivot; those from the pubes, shorter than the rest, pass transversely outwards, and are inserted into the lower part of the linea quadrati, and into the line prolonged from the linea aspera to the great trochanter; others pass with varying degrees of obliquity downwards and outwards, to be inserted into the whole length of the linea aspera, and into a part of its internal bifurcation below, where they end in a pointed process; finally, some of the fibres descend almost vertically, forming the inner border of the muscle, and terminate in a rounded tendon, which is inserted into the tuberosity on the inner condyle of the femur. The muscle thus presents two parts; one is a broad plane, inserted into the femoral lines, and forming a septum between the anterior and posterior muscles of the thigh; the other is the thick elongated part which goes to the condyle: between them an angular interval is left for the transmission of the femoral vessels backwards into the popliteal space. This muscle forms the greater part of the fleshy mass at the inner side of the thigh. The muscular Adductor magnus. Deep position. Origin. Fibres diverge. Their various lengths and direction. Extensive insertion.

substance is arranged in large and easily separable bundles; it is connected by tendinous fibres with the pelvis, and ends on the femur in a broad aponeurosis and the tendon already noticed.

Parts adjoining. The upper or shortest border of the adductor magnus is parallel with, and close to the quadratus femoris; the internal, or longest border, is covered by the fascia lata, the gracilis, and sartorius; the external border (its femoral attachment) is interposed between the two other adductors and the vastus internus, which lie in front of it, and the gluteus maximus and short head of the biceps, which separate it from the vastus externus. The posterior surface is covered by the great sciatic nerve and hamstring muscles; the anterior by the sartorius, the adductor brevis and longus, and the blood vessels. The anterior surface of the muscle is intimately blended with the adductor longus before it reaches its insertion; it also sends off an aponeurosis, which passes in front of the femoral vessels, and unites with the vastus internus; finally, its prolonged tendinous portion is intimately connected with the last-named muscle. **Space for femoral vessels.** The interval left between the two parts of this muscle for the passage of the femoral vessels is triangular in form, and fleshy and tendinous in structure, when viewed from behind; but at the anterior aspect it is altogether tendinous in its entire extent, and oval in its form.

Actions of adductor muscles, if the limb is moveable; *Actions.*—These are the direct adductors of the femur, and their force must be considerable, from both their strength and number. As the linea aspera projects from the shaft of the bone, the adductors are removed proportionally from its axis, and so are enabled to rotate it outwards, thus conspiring with a distinct class of muscles, the external rotators. If the limb is abducted, they will draw it inwards, the gracilis assisting, and will finally place one thigh over the other. The femur may be bent on the pelvis by the action of the pectineus, and the adductor longus and brevis, thus combining with the psoas and iliacus: in walking too all assist powerfully in bringing forwards the hinder limb.

if the limb is fixed. When the lower extremities are firmly fixed on the ground these muscles contribute to maintain the body in the erect position, by taking their fixed point below, and thence acting on the pelvis. If the action is continued, the pectineus and the adductor longus and brevis may be made to flex the pelvis on the femur, by drawing the pubes downwards.

POSTERIOR FEMORAL REGION.

At the back of the thigh are the three long flexor muscles of the knee-joint; viz., the biceps, semi-tendinosus, and semi-membranosus. They are immediately subjacent to the skin and fascia, except at their superior attachment.

The *dissection* of this group should follow that of the muscles in the gluteal region. From the middle of the incision made along the fold of the nates, or from opposite the middle point between the ischial tuberosity and the great trochanter, carry an incision through the skin straight along the back of the thigh and popliteal space, so as to mark out the median line of both. Let this extend to about three inches below the flexure of the knee-joint, and be there bounded by a transverse incision five or six inches in length. Make a similar transverse incision at the union of the middle with the lower third of the thigh. Now with the forceps pinch up the angles of these flaps of skin, and carefully dissect them off the subjacent fascia, which will be recognised as a smooth shining membrane. Examine this carefully in its whole extent. At the lower part of the thigh it is stretched tightly across from side to side, covering an angular space (popliteal space or the ham), enclosed by the flexor or ham-string muscles; viz., those which are about to be examined. Make an incision through the fascia from above downwards, along the middle of this space; bound it above and below by two transverse cuts. Pinch up the flaps of fascia tightly, and dissect them off the muscles: continue the same process upwards, until you expose the muscles in their entire extent. Dissection of the back of the thigh;

The lower attachment of the semi-membranosus requires attention. To gain a clear view of it, the muscle may be cut across in the ham and drawn down; when, by holding it tense, one set of fibres will be observed to pass along the inner tuberosity of the tibia, another obliquely upwards behind the joint, whilst the third goes perpendicularly downwards, joining a dense fascia over the popliteus muscle, and is ultimately continuous with the deep fascia of the leg. and for insertion of semi-membranosus.

Biceps femoris (biceps flexor cruris; ischio-femoro-peronealis).—This muscle is situate at the posterior part of the thigh, and consists superiorly of two heads. These extend, one from the hip-bone (the long head), the other from the femur (short head), and unite to terminate on the fibula. Biceps femoris.

The long head (fig. 127,[5]) *arises* by a tendon common to it and the semi-tendinosus, from an impression on the back part of the ischial tuberosity. Long head.

The femoral portion,[6] or the short head, is attached to the femur from the insertion of the gluteus maximus nearly to the outer condyle,—arising from the linea aspera, from the line leading to the outer condyle except two inches below, and from the external intermuscular septum between the adductor magnus and vastus externus muscles. Short head.

The fibres of the former end on an aponeurosis

which covers the lower part of the muscle. This aponeurosis likewise receives the muscular substance of the short head, and is then narrowed into a tendon which is *inserted* into the head of the fibula by two portions, that are separated by the external lateral ligament of the knee-joint; and one of these passing forwards is inserted into the tibia. An expansion is likewise given off, which strengthens the fascia of the leg.

Insertion into fibula and tibia.

Parts adjacent.

This muscle is covered by the gluteus maximus and the fascia lata. In front it lies against the semi-membranosus, the sciatic nerve, and adductor magnus; and inferiorly against the gastrocnemius, with the external articular vessels. The external popliteal nerve is to the inner side.

Semi-tendinosus.

Joined with biceps at origin.

Tendon is long.

Insertion.

The *semi-tendinosus* (fig. 127,[7]) (ischio-præ-tibialis) is situate at the posterior part of the thigh. It *arises* from the posterior part of the tuber ischii, close to the inner side of the biceps, and continues to arise from the tendon of that muscle for three inches lower down, somewhat in the same way as the coraco-brachialis does from the biceps of the arm. A little below the middle of the thigh it ends in a long round tendon, from the length of which the muscle is named. The tendon, after passing on the semi-membranosus along the inner side of the popliteal space, is reflected forwards, to be *inserted* for the distance of half an inch into the inside of the upper part of the tibia, where the tendon is on the same plane but below that of the gracilis—both being under cover of the sartorius.

Adjacent parts.

The semi-tendinosus, except where it is concealed at its origin by the gluteus maximus, is covered by the fascia lata: the anterior surface rests on the semi-membranosus in the greater part of its extent; towards its termination, it runs over the lateral ligament of the knee-joint. A tendinous intersection about the middle of the muscle characterises it. At its insertion there is a bursa between it and the sartorius, and the ligament of the joint.

Semi-membranosus.

Origin under preceding.

Insertion in three parts.

Semi-membranosus (fig. 127,[8]) (ischio-poplito-tibialis.)—This muscle *arises* from the posterior part of the ischial tuberosity, above and to the outer side of the origin of the biceps and semi-tendinosus, and behind the quadratus femoris. It is *inserted* beneath the internal lateral ligament of the knee-joint into the back of the inner tuberosity of the tibia, some fibres joining that ligament; and it sends off the two following tendinous bands,—one joins the deep fascia, the other broad and expanded, is reflected backwards and upwards behind the joint, and becomes identified with the

that position. Now, make an incision through the skin, beginning above at the middle point between the head of the fibula and the spine of the tibia, and continue it straight down over the middle of the ankle-joint and dorsum of the foot. As this is a very long incision, intersect it by a transverse one at each end, and another in the middle. Raise the flaps of skin tightly, and beneath them will be seen the dense fascia of the leg; dissect back the flaps, and expose this membrane in its entire extent.

of the muscles.

To see the muscles:—Divide the fascia along the leg in the same way as the skin was cut, but opposite the flexure of the ankle-joint leave undivided two bands of it: one about two inches wide above the ends of the bones; the other narrower in front of the ankle-joint, where it stretches obliquely from the one side of the foot to the other, forming the anterior annular ligament. Beginning a little above the ankle, raise the fascia from the tendons, and, taking them as the guide, dissect it from below upwards as far as possible from the muscles.

Position of the muscles.

Position of the leg muscles.—The muscles of the leg, taken altogether, may be divided into sets, each consisting of three. Thus, on the fore part of the leg, and lying between the tibia and fibula, are the tibialis anticus, the extensor communis, and extensor pollicis,—being the group which is now to be examined. On the external side of the leg, and in close contact with the fibula, are placed the peroneus longus and brevis. The third muscle of this name is generally considered a part of the extensor communis, and is separated from the other two by the breadth of the fibula: it still may be described as a separate muscle, and in this case it will keep up the ternary division. Posteriorly there are two sets; one being superficial, consisting of the gastrocnemius, soleus, and plantaris; and the other deep-seated; viz., tibialis posticus, flexor longus digitorum, and flexor longus pollicis.

Tibialis anticus.

Origin from several sources.

The *tibialis anticus*,—Cowper (tibio-super-tarseus,) (fig. 130,[1]) is situate on the front of the leg, being extended along the outer side of the tibia, and reaching to the inner part of the tarsus. It *arises* from the external tuberosity of the tibia, and about two-thirds of the outer surface beneath it; from a small portion of the adjoining inter-osseous ligament; from the strong fascia of the leg; and from an aponeurotic septum placed between it and the extensor digitorum com-

The tendon.

munis muscle. The fleshy fibres end in a tendon which is at first concealed among them, and becomes apparent at the anterior surface of the muscle towards the lower third of the leg. The tendon, freed from the muscular substance, passes through the inner compartment in both pieces of the anterior

Insertion.

annular ligament, and is *inserted* into the internal and lower

part of the first cuneiform bone, and the contiguous extremity of the first metatarsal bone. This muscle has considerable breadth at its origin, but it gradually lessens in size towards the lower part of the leg, as the fleshy fibres end on the tendon.

Fig. 130.*

Contiguous structures.

The tibialis anticus is covered by the fascia, which adheres to the muscular structure above, and gives origin to a considerable number of its fibres. It rests against the interosseous membrane in the greater part of the length of the leg, but inferiorly the tendon is supported by the fore part of the tibia. And it has on one side the bone just named; on the other side, the extensor digitorum communis and extensor pollicis pedis. The anterior tibial artery and nerve lie along the outer side of the muscle, between it and the two muscles last mentioned. On the foot the tendon lies over the tarsal bones, and is contiguous to the short extensor of the toes.

Tibial artery and nerve outside muscle.

Musculus catenæ.

The tibialis anticus was named "Musculus catenæ" by Spigelius, for a reason which, even if it were correct as to the fact, seems a singular one to found a nomenclature on, namely, that the tendon being divided or removed, the sufferer is compelled to raise the foot in walking with the aid of a sling.†

Extensor pollicis.

Extensor proprius pollicis,—Alb. (fig. 130,[3]).—The special extensor of the great toe is placed at the fore part of the leg and along the inner border of the dorsum of the foot, between

* A front view of the leg and foot after the removal of the integument and fascia. 1, is on the tibia, and points to the tibialis anticus. 2. Annular ligament. 3. Extensor proprius pollicis. 4. Extensor longus digitorum pedis. 5. Peroneus tertius. 6. Extensor brevis digitorum. 7. Peroneus longus. 8. Peroneus brevis. 9, 10. Gastrocnemius and soleus.

† "Ab aliis tibiæus anticus, à me *catenæ musculus* vocatus, quòd dissecto per transversum huius tendine, aut amputato, catenam ægri, cuius beneficio ambulantes pedem flectant eleuentque, portare cogantur."—"De h. corp. fabr." l. iv. c. 24.

the muscle last described and the extensor digitorum communis. This muscle is elongated, flat, and compressed in the middle, pointed at the extrĕmities. It *arises* from the middle three fifths of the anterior narrow part of the inner surface of the fibula, and from the contiguous portion of the inter-osseous ligament for the same extent. The fleshy fibres run obliquely forwards into a tendon placed at the anterior border of the muscle; and the tendon, after passing beneath the upper, and through the lower portion of the annular ligament in a distinct compartment, and along the dorsum of the foot, is *inserted* into the base of the second phalanx of the great toe. A delicate expansion given from the tendon on each side spreads over the joint between the metacarpal bone and the first phalanx.

Its position. Origin. Insertion.

Adjoining structures.

Placed between the extensor digitorum communis, and the tibialis anticus, the extensor pollicis is overlapped for some way by these muscles; and on the foot it is covered like the other tendons only by the integument and fascia. It rests successively on the anterior surface of the tibia, the ankle-joint, and the bones of the foot. This muscle changes its position with respect to the anterior tibial artery, being outside that vessel on the leg, while it lies to the inner side on the foot, after having crossed over it opposite the annular ligament.

Changes position with respect to artery.

Extensor longus digitorum.

Extensor longus digitorum pedis (fig. 130,[4]).—The long extensor of the toes is situate at the fore part of the leg and on the dorsum of the foot, extending from the head of the tibia to the toes. It is thin, or flattened from side to side, and at the lower end divides into four tendons. This muscle *arises* from the external tuberosity of the tibia: from the head and the anterior narrowed part of the inner surface of the fibula in front of the inter-osseous membrane, for about three-fourths of its length; from a small part (about an inch above) of the interosseous ligament; also from the aponeurotic septa intervening between it and the muscles on each side, and from the fascia of the leg. The fleshy fibres from this extensive origin pass obliquely into three flat tendons placed on the fore part of the muscle. These descend through the lower part of the annular ligament, in the same sheath as the peroneus tertius; and on the dorsum of the foot the inner one divides into two parts, so as to increase the number of tendons to four. The tendons belong to the four smaller toes, and are joined at the outer side on the first phalanx by the tendon of the extensor brevis digitorum,

Origin from several parts.

The tendons.

Joined by extensor brevis,

as well as by tendinous processes from the lumbricales and interosseous muscles; and thus a fibrous expansion is produced, which covers the first phalangal bone of the toe. The tendinous expansion divides, in the manner of that of the corresponding muscle of the hand, into three parts: the middle division is inserted into the base of the second phalanx; and the two lateral parts, after joining together, terminate on the last phalanx. But the fourth tendon (that of the little toe) is not joined by an offset from the short extensor of the toes. From the tendons, slender bands spread over the joints of the metatarsal bones with the phalanges: the same arrangement exists in the hand.

lumbricales, and interossei.

Insertion into last two phalanges.

The long extensor of the toes is covered only by the integument and fascia. It is placed between the tibialis anticus with the extensor of the great toe on the one side, and the peronei muscles on the opposite side; and it rests successively against the bones of the leg, with their connecting interosseous membrane, the ankle-joint, and the short extensor of the toes.

Contiguous parts.

Five tendons are ascribed to this muscle by Cowper;* the fifth, with the fleshy fibres it receives, being the muscle, or, more properly, the part of the long extensor commonly known as the "peroneus tertius."

The *peroneus tertius* is placed along the lower third of the inner part of the fibula, and lies just below the extensor longus, with which its muscular fibres[5] are united, and of which it may be considered but a portion. It *arises* from the lower fourth of the inner surface of the fibula in front of the attachment of the membrane between the bones; also from the lower part of the interosseous ligament, and from an aponeurosis which connects it on the outer side with the peroneus brevis. The muscular fibres end in a tendon, which, after passing through the annular ligament with the long extensor of the toes, is *inserted* into the upper surface of the base of the fifth metatarsal bone, and likewise in some instances into the fourth.

Peroneus tertius sometimes part of preceding.

Attachments.

The peroneus tertius is liable to some deviations from the ordinary disposition. The part of the muscular structure which would be assigned to it may be equal in size to that which belongs to the extensor tendons of the toes. The tendon only may have much more than the

Peculiarities.

* Myot. Reform., c. 36, p. 111.

ordinary size. It has been observed to terminate on the fourth metatarsal bone and the fascia covering the foot. And the muscle may be altogether wanting.

Extensor brevis digitorum. *Extensor brevis digitorum pedis.*[6]—The short extensor of the toes is a broad and thin plane of muscular fibres on the dorsum of the foot, which is divided at its anterior extremity into four small parts. Its position. It *arises* from the outer surface of the os calcis in front of the groove for the peroneus brevis muscle, and from the lower band of the anterior annular ligament. In front it terminates in four tendons; Insertion on four inner toes. the first or most internal of these is inserted separately into the tarsal end of the first phalanx of the great toe; and the other three become severally united to the outer border of the extensor tendons proceeding to the three next toes.—This muscle is covered by the tendons of the long extensor and peroneus tertius; and it rests on the tarsus, the metatarsus, and the dorsal inter-osseous muscles. The part destined for the great toe crosses over the dorsal artery of the foot.

Action on the toes: *Actions.*—A very slight effort of the extensor communis and extensor proprius pollicis extends the digital phalanges, and, if their action be continued, they will be made to bend the foot upon the leg. This they are enabled to do by the manner in which their line of direction is altered by the annular ligament of the ankle-joint, which gives them the same kind of action as in a pulley. The extensor brevis is obviously but an accessory to the long extensor; but from the obliquity of its direction, it is fitted not only to extend the toes, but to draw them somewhat outwards.

on the foot; The tibialis anticus and the peroneus tertius are the direct flexors of the foot on the leg; and if either acts separately, it will give a slight inclination towards the corresponding side.

on the bones of the leg. In the erect position of the body these muscles take their fixed point below, and, by drawing on the bones of the leg, keep them perpendicularly on the foot.

Peroneus longus. *Peroneus longus* (peroneo-sub-tarseus) (fig. 126,[7]) lies at the outer side of the leg, and under the foot. Origin. It *arises* from the head of the fibula, and more than the two upper thirds of the external surface of that bone; from the fascia of the leg; and from aponeuroses interposed between it and the contiguous muscles, viz. the extensor communis digitorum on one side, and the soleus and flexor longus pollicis on the other. Proceeding from these attachments, it descends

and becomes tendinous. The tendon freed from the muscular structure at some distance from the foot, passes, with that of the peroneus brevis, in a hollow on the posterior surface of the external malleolus, where they are covered by a fibrous band extended from the end of the fibula to the calcaneum, and invested by a common synovial membrane. The tendons then separate; that of the peroneus longus proceeds obliquely forwards in a groove on the external surface of the calcaneum, to which it is connected by a separate fibrous band, lubricated by the synovial sac. It then turns over the outer margin of the foot, enters the excavation on the lower surface of the cuboid bone, and is covered by a synovial membrane. From this point the tendon, contained in a sheath, inclines forwards and inwards across the foot immediately beneath the bones, and is inserted into the internal cuneiform, and the tarsal end of the first metatarsal bone: an offset is continued from it to the base of the second metatarsal bone. The muscle therefore changes its direction at two points, namely, behind the lower end of the fibula and on the cuboid bone; and the bones on which it turns are to be considered as pulleys, changing the direction of the muscular power. At the two points of reflection the tendon is thickened and indurated; at the lower one a sesamoid bone is often deposited in it.

Passes behind malleolus.

In groove of cuboid bone.

Insertion.

Two changes of direction.

Tendon thickened.

The peroneus longus is placed immediately beneath the fascia of the leg, and lies between the extensor longus digitorum and peroneus tertius before it, and the soleus and flexor longus pollicis in the opposite direction. In the foot it is above all the plantar muscles, being near the bones.

Parts adjacent.

Peroneus brevis (semi-fibulæus,—Spigelius) (fig. 126,[8]).—This muscle lies beneath the preceding, and is considerably shorter than it, neither reaching so high on the leg, nor extending so far on the foot.

Peroneus brevis.

It *arises* from the two lower thirds of the external surface of the fibula, internal to the peroneus longus, and from the intermuscular septa which dip between it and the contiguous muscles. From these sources the fibres are directed to a tendon lying on their outer surface, a portion of them reaching as low as the malleolus. The tendon passes behind the external malleolus in the same groove and sheath as the preceding muscle; is invested by the same synovial membrane; and inclining forwards beneath the fibula, is *inserted*

Origin.

Insertion.

into the projection at the base of the last metatarsal bone, after having traversed a separate sheath on the calcaneum above that for the tendon of the peroneus longus, but lined by an offset of the same synovial membrane.

Action of peronei on the foot; *Actions.*—The peroneus longus and brevis, by the change of their direction after turning behind the external ankle, are enabled to draw the foot back, and so extend it on the leg. The peroneus tertius is, on the contrary, a flexor of the foot: it lies before the fibula, and combines with the extensor communis. The peroneus longus is enabled to evert the sole of the foot, by means of the tendon turning round the external margin. This however is not readily perceptible in the natural condition of the limb; but, if the fibula be fractured, and the check afforded by that bone be in consequence diminished, the movement will take place to a considerable extent.

and on the leg. When the peronei take their fixed point below, they act on the bones of the leg, and assist in placing and maintaining them erect on the foot. This power is chiefly called into action when we stand on one leg. The weight of the body must then tend to incline the leg inwards; but the peroneus longus, acting from its fixed point in the sole of the foot, round the border of which it turns as over a pulley, draws on the external side of the bones of the leg, and prevents them from obeying the influence which otherwise would incline them inwards.

POSTERIOR TIBIO-FIBULAR REGION (SUPERFICIAL).

Two sets of muscles at back of the leg. On the posterior part of the leg there are two sets of muscles; one superficial, the other deep-seated. The latter consists of muscles, which are the antagonists of those in front, viz., the tibialis posticus, flexor digitorum longus, and flexor pollicis longus; together with the popliteus, which is placed above these muscles, and close to the knee-joint.

The superficial is large in man; The superficial muscular structure (extensor tarsi suralis vel extensor magnus,—Douglas; musculus suræ, Sœmmerring) is a large mass, and constitutes the calf of the leg. Its great size is characteristic of man: for it is connected with his peculiar mode of progression, and is calculated to elevate the heel in opposition to the weight of the entire body.

joined below in one tendon. At the lower end the mass is narrowed into a single tendon (tendo Achillis) which is attached to the heel; but

the muscular substance is divided into two thick strata, connected, the one with the femur, the other with the bones of the leg.

Dissection of the muscles.

Dissection.—The gastrocnemius may be exposed without any difficulty by dissecting off the fascia, commencing where it is continuous with that covering the popliteal space ; after which, the internal head of the gastrocnemius may be raised, and its border reflected outwards. By this expedient the thin tendon of the plantaris will come into view, and afford a guide to its muscular belly, which may otherwise be raised with the external head of the gastrocnemius, with which it is close in contact. The soleus may in the next place be detached, taking the inner surface of the tendo Achillis as a guide ; previously to which, attention should be directed to the fibrous structure of that part of its upper border, between the tibial and fibular origins, which is arranged for the transmission of the posterior tibial vessels.

Fig. 131.*

Gastrocnemius.

The *gastrocnemius*, (fig. 127,[4]) (gemellus,—Cowp. ; bifemoro-calcaneus) is situate at the posterior aspect of the leg, forming the greater part of what is named the calf (*γαστηρ*, a belly ; *κνημη*, the leg).

Two heads.

It consists of two parts (hence the second of the names above applied to the muscle †), the internal of which is the larger. At the upper extremity the two parts diverge, and form the lower boundaries of the popliteal space : they are named "heads," and are distinguished as "external" and "internal."

Origin.

Each head *arises* by a thick tendon from the corresponding condyle of the femur ; the outer one being fixed chiefly to a pit on the outer aspect of its condyle above the hollow for the popliteus ; and the inner one to an impression on the upper and hinder part of its appertaining condyle : each is also attached higher up by a few tendinous fibres,

* The superficial muscles on the posterior part of the leg are here shown. 1. Semi-tendinosus. 2. Semi-membranosus. 3. Biceps. 4. Gastrocnemius. 5. Soleus. 6. Tendo Achillis. 7. Plantaris.

† "Sunt *gemelli*, quia mole, robore, et actione pares."—Riolanus, l. 5, c. 43.

and on the inner side fleshy fibres are connected for a short space with the ridge running to the linea aspera. The tendon spreads out behind, and gives origin on its anterior surface to a large mass of muscular fibres. Some of the innermost muscular fibres from both sides meet at an angle on a tendinous structure below, which is common to them; but the two parts are not confounded one with another, and a groove indicates the place of separation. The great mass of the fleshy fibres is directed downwards and forwards, from the aponeurosis of origin behind, to one of insertion in front of the muscle. And the latter, gradually contracting, joins with another from the soleus to form the tendo Achillis.

Arrangement of tendon and fleshy fibres.

Parts adjoining.

The gastrocnemius is covered by the fascia of the leg, and the short saphenous vein lies on it opposite the interval between its two parts. It conceals the plautaris, the soleus, and the popliteus, with the popliteal vessels and the internal division of the sciatic nerve. The "heads" are placed between the hamstring muscles; and between the external one and the biceps is lodged the peroneal nerve. Over the condyles these parts of the muscle are in contact with the thin fibrous capsule of the knee-joint. A synovial bursa (which in some cases communicates with the synovial membrane of the joint) is interposed on the inner side. And a sesamoid fibro-cartilage will sometimes be met with over the outer condyle, occcasionally over the inner likewise: the last-mentioned substance is rarely osseous.

Synovial bursa.

Fibro-cartilage.

Soleus.

The *soleus*[5] (tibio-peroneo-calcaneus) is placed beneath the preceding muscle, in conjunction with which it forms the calf of the leg. It is shorter than that muscle, but it extends farther down before ending in the common tendon. In form the soleus is elliptic, and the name is said to be taken from the likeness to the shape of a sole-fish. Like the gastrocnemius, it presents superiorly two attachments, though by no means so distinctly separated.

Extends lower than preceding.

Origin from bones of leg and a fibrous arch.

Of these, the external one, the longer and larger, *arises* from the posterior part of the head of the fibula, and from the surface beneath it along half of the bone; the inner portion *arises* from the oblique line which gives insertion to the popliteus, and from the posterior edge of the tibia about three inches below that line; and, in the space intermediate between the bones, the muscular fibres are attached to a tendinous band extended from one to another over the

posterior tibial vessels. The attachment to the bones is effected by tendinous structure, which expands on the anterior surface of the muscle, and enters to some extent into its interior. The muscular fibres, taking origin from the tendinous expansion referred to, are directed backwards to a thin aponeurosis which spreads over the posterior surface; and this aponeurosis, diminishing in breadth and increasing in thickness, joins with that from the gastrocnemius to form the tendo Achillis. Tendon of origin.

The soleus is covered by the gastrocnemius, and between the two muscles is placed the slender tendon of the plantaris. It covers the deep-seated muscles, and the posterior tibial vessels and nerve. Parts over and under.

The *tendo Achillis** (chorda magna) is much the thickest and strongest tendon in the body. Formed by the junction of the terminal aponeuroses of the two preceding muscles, it measures about six inches in length, and is inserted into the lower part of the tuberosity of the os calcis. It is expanded at its extremities, and most so at the upper one. The tendon is covered by the fascia and integument; and it is separated from the fascia covering the deep-seated muscles and vessels by a considerable interval, which is occupied with fat and connective tissue. Between the upper part of the os calcis and the tendon a synovial bursa is interposed. Tendo-Achillis. Interval between tendon and deep structures. Synovial bursa.

The gastrocnemius is, in some cases, joined by a bundle, which arises separately from the femur above one of the condyles. This accessory slip ends variously, either joining the middle of the muscle on its deeper surface, or blending with one of its heads. Illustrations of different forms of this peculiarity have been given elsewhere.† In one of the cases referred to, the unusual muscular fibres passed between the popliteal artery and vein.—To the soleus an accessory portion is occasionally added at the lower part of its inner margin. The thick bundle of muscular fibres, added to this muscle, presents some variations in its extent and manner of termination: it usually ends on the inner side of the tendo Achillis, but it may form a tendon, attached separately to the os calcis.‡ Accessory slips.

The *plantaris*[7] is situate immediately behind the knee-joint and the leg, between the gastrocnemius and soleus; it consists of a very long thin tendon, and a small pyriform muscular part, about two inches in length. It *arises* from the femur just above the external condyle, and from the Plantaris. Origin.

* So named because Achilles was vulnerable only at the heel.
† Op. citat. plate 80, figures 4 and 5. ‡ Ibid.

posterior ligament of the knee-joint, where this is covered by the corresponding head of the gastrocnemius; and soon ends in a delicate tendon, which inclines inwards between the two large muscles of the calf of the leg, and running Insertion. along the inner border of the tendo Achillis is inserted conjointly with it into the posterior part of the calcaneum.

Name inapplicable. The designation by which this little muscle is known has no reference to its position or connections; but its name was assigned to it when the tendon was thought to terminate in the plantar fascia, as the palmaris longus does in the fascia of the hand. It was so described by Galen: and, though the real manner of termination was correctly pointed out by Vesalius, (Oper. 1, 2, p. 419,) the error was continued through many valuable works. It exists even in Cowper's "Myotomia Reformata" (p. 105).

Peculiarities. The plantaris varies in its mode of termination: it is sometimes encased in the lower part of the tendo Achillis; and, in other cases, the tendon ends in the internal annular ligament, which binds down the tendons and vessels behind the inner malleolus.

Action of foregoing muscles in walking; *Actions.*—The power of these muscles, as it is exerted successively in standing, walking, running, &c., is very considerable.

In walking, the gastrocnemius and soleus take their fixed point above, and by drawing on the os calcis lift it from the ground, so that the foot is made to represent an inclined plane. By this action an impulse forwards is communicated to the body, as in progression. When the body is thus supported on the elevated foot, the opposite limb can be carried forwards to its destination, unimpeded by the inequalities of the surface over which it has to pass.

standing; In standing, the soleus takes its fixed point at the os calcis, and by drawing on the bones of the leg, retains them perpendicularly on the foot, thus preventing them from obeying the influence of the weight of the body, which constantly tends to bend them forwards.

stooping; If the action from below be carried as far as it will admit of, the gastrocnemius and popliteus will bend the femur on the tibia; and if at the same time the semi-tendinosus, semi-membranosus, and biceps be made to act on the pelvis, so as to draw it downwards and backwards, the commencement of that series of muscular actions is made by which the body is retroverted, and carried towards the ground, as we see when a tumbler arches his body backwards, the head and heels being brought to the same plane.

POSTERIOR TIBIO-FIBULAR REGION (DEEP-SEATED).

The muscles of this region are in close contact with the bones; they are the popliteus, flexor longus digitorum, flexor longus pollicis, and tibialis posticus.

Dissection.—To expose the deep fascia:—Detach the two heads of the gastrocnemius from the condyles, also the plantaris; then separate the soleus from the tibia and fibula, proceeding from below upwards. When this is done, turn these muscles down towards the foot, and behind and just beneath the knee-joint the popliteus muscle will appear; it may be observed, that this as well as the long muscles which lie lower down, and the posterior tibial vessels, are bound down by a thin fascia (the deep-seated fascia of the leg). This membrane extends down from the knee-joint, becoming connected on each side with the borders of the bones, and towards the ankles with the sheaths of the tendons; and, if traced along the interval between the inner ankle and the heel, it will be found to cover the vessels, and to terminate at the internal annular ligament. Dissection of the deep fascia.

To expose the deep-seated muscles:—Pinch up the fascia with the forceps, and detach it from the tendons of the muscles behind the ankle:—taking these as a guide, proceed upwards to the popliteus. In this way the deep-seated set of muscles become exposed, viz. the flexor communis, placed along the tibia, the flexor pollicis on the fibula, and the tibialis posticus between both, and partly concealed by them; and also the vessels which rest upon them. The deep layer of muscles.

Fig. 132.*

The *popliteus* (fig. 132,[4]) is situate immediately behind and beneath the knee-joint, extending from the external condyle of the femur downwards and inwards to the tibia. It is flat, and somewhat triangular in its form, for it gradually widens as it descends. The popliteus *arises* inside the capsule of the knee-joint by a thick tendon, about an inch in length, from the fore part of a depression on the outer side of the external condyle, Popliteus. Origin from pit on external condyle.

* The deep-seated muscles of the back of the leg are exposed. 1. Semi-membranosus. 2. Peroneus longus. 3. Peroneus brevis. 4. Popliteus. 5. Flexor digitorum longus. 6. Flexor longus pollicis. 7. Tibialis posticus.

brevis, which tends to turn it outwards. It may also, by elevating the inner border of the foot, turn the sole inwards; this action is directly opposed to that of the peroneus longus, which inclines it outwards.

Action of foregoing on leg.

The action of these muscles may be reversed; for they may take their fixed points below at the foot, and thence draw on the bones of the leg, so as to raise these from their oblique position in the stooping posture, and to keep the same in the erect position and prevent their inclining forwards in standing.

MUSCLES OF THE SOLE OF THE FOOT.

The only muscle on the dorsum of the foot is the extensor brevis digitorum, which has been already described (page 164), together with the extensor longus, as they agree in their actions.

Muscles of sole of foot.

Three sets.

The present section includes only the muscles in the sole of the foot. These may be considered as occupying three regions, corresponding with the two borders and the intermediate space; the internal set consisting of the muscles of the great toe, the external, of those of the little toe, and those in the middle being common to all. But it is found more convenient to divide them into layers, lying one beneath another; more particularly as, like the muscles on the back part of the leg, they are found to be separated into a superficial and deep set by a layer of fascia interposed between them and binding down the latter.

Division into layers.

Dissection of plantar fascia.

Dissection.—To expose the plantar fascia:—The limb being placed in the prone position, lay the foot on a high block, so as to bring the sole fully into view; secure it in that position. Make an incision from behind forwards in the middle of the sole, beginning over the heel. Cut down through the thick skin and the cushion of granular fat at the heel, until the white fibres of the fascia are seen: then taking these as a guide, and everting the margins of the incision, dissect the skin off the fascia from behind forwards. The middle part of the fascia spreads out beneath the metatarsus, and gives off five processes, which run along to the extremities of the metatarsal bones: the external portion, which binds down the muscles of the little toe, is thick and firm; but the internal one, which corresponds with the muscles of the great toe, is a thin membrane which appears to be prolonged from the fascia on the dorsum of the foot, and not to be properly an offset of the true plantar fascia (see its description, among other structures of the same kind).

Granular fat over fascia.

Divisions of the fascia.

First layer of muscles.

To expose the first layer of muscles (fig. 133):—These are three, viz. the abductor pollicis at the inner side, the abductor of the little toe at the outer, and the short flexor of the toes in the middle. The abductor

pollicis is readily brought into view by raising the thin fascia which covers it, and dissecting it off, beginning over its tendon and thence proceeding backwards. The abductor of the little toe is exposed by raising the outer division of the plantar fascia from its attachment to the fifth metatarsal bone and reflecting it backwards. Now observe that the central part of the fascia appears as if tucked in at its sides by processes or septa, which separate the middle from the lateral groups of muscles. Insert the knife under the fascia, raise it from the muscles a little, and then cautiously detach it from them, proceeding from before backwards. By these means the short flexor muscle will be brought into view.

Abductor pollicis.

Abductor pollicis pedis (fig. 133,[1]).—The abductor of the great toe is placed horizontally along the inner side of the sole of the foot. It *arises* from the inner part of the larger protuberance of the calcaneum, from the internal annular ligament and the tendinous and fibrous structures on the inner border of the foot as far forwards as the internal cuneiform bone, from the septum between it and the flexor brevis digitorum, and from the surface of the plantar fascia. The fleshy fibres end in a tendon, which, after uniting with the external head of the flexor brevis pollicis, is inserted into the inner border of the base of the first phalanx of the great toe.

Origin.

Joins with flexor brevis.

Fig. 133.*

Parts adjacent.

The plantar surface of this muscle is covered by the skin and fascia; the opposite surface is in contact with the tendinous insertion of the tibialis posticus, with the flexor brevis pollicis with which it is identified, and with the internal plantar vessels.

Flexor brevis digitorum.

Flexor brevis digitorum[2] (flexor perforatus).—The short flexor of the toes is placed in the middle of the sole of the foot, in contact with the plantar fascia. It *arises* by a small pointed and tendinous attachment from the inner part of the greater tuberosity of the calcaneum; from the plantar fascia[3]; and from the intermuscular septum on each side. The muscle soon terminates in four thin tendons correspond-

* The muscles seen after removing the integument and fascia only. 1. Abductor pollicis. 2. Flexor brevis digitorum. 3. A part of the plantar fascia. 4. Abductor minimi digiti.

Tendons, perforated by flexor longus.

ing with the four smaller toes; and opposite the middle of the first phalanx each tendon is slit longitudinally, so as to give a fissure for the transmission of the tendon of the flexor longus; finally the tendon divides into two processes which are inserted into the sides of the second phalanx. The manner of its division for the passage of the other flexor tendon, and the mode of connection with the bones, are the same as in the hand.—The lower surface of this muscle is in intimate contact with the plantar fascia; the upper with the flexor accessorius, with the tendons of the flexor longus digitorum, the lumbricales, and the plantar vessels and nerves.

Arrangement same as in hand. Parts in contact.

Abductor minimi digiti. Origin.

Abductor minimi digiti.[4]—This, the third muscle of the superficial stratum, is placed along the external border of the foot. It has a wide origin behind, from the front of both tubercles on the under surface of the os calcis, from the external intermuscular septum, and from the upper surface of the process of the plantar fascia which extends from the external tubercle to the base of the fifth metatarsal bone. The fleshy fibres end in a tendon, which, after sliding along a smooth impression on the inferior surface of the base of the fifth metatarsal bone, is *inserted* into the external surface of the base of the first phalanx of the little toe.

Insertion.

Parts in contact.

This muscle is covered by the plantar fascia. Its upper surface is in contact with the external head of the flexor accessorius, the ligamentum longum plantæ, the peroneus longus, and the flexor brevis digiti minimi.

Removal of first layer of muscles.

Dissection.—To expose the second layer of plantar muscles (fig. 134), separate the two abductors and the short flexor from the calcaneum by inserting the knife under the border of each successively, and cutting obliquely backwards close to the bone. Then draw them forwards, leaving them still attached by their insertions, in order that they may be restored again to their original positions, and their attachments and relations inspected.

Tendons of long flexors with accessories of flexor digitorum.

When these muscles are removed, a thin lamella of membrane (*deep plantar fascia*) will be observed, extending across from the one side of the foot to the other, and separating the first from the second muscular layer. In this layer are the tendon of the flexor longus pollicis, and the flexor communis with its accessories, viz. the flexor accessorius and lumbricales. The long tendons will be observed to cross one another at an acute angle, that of the flexor pollicis inclining inwards and placed on a plane superior to the tendon of the flexor communis, whose direction is obliquely outwards, as if towards the base of the fifth metatarsal bone.

[illegible]

The *flexor accessorius* is divided posteriorly into two heads,

inner and outer (fig. 134,[3],[3]) : the internal or larger one is fleshy, and *arises* from the inner or concave surface of the calcaneum ; the external, flat and tendinous, arises from the plantar surface of that bone, a little before its external tubercle, and from the long plantar ligament. These origins unite at an acute angle, and form a flat fleshy mass, whose tendinous fibres become united to the external border, as well as to the upper surface, and slightly also to the lower surface of the tendon of the flexor longus at the point of division. It may be observed, that the tendinous fibres of the accessory muscle enclose the tendon of the long flexor, and are so arranged as to form a groove, within which it is lodged. Origin and Ending.

Fig. 134.*

The flexor accessorius is the "moles carnea" of Sylvius.†

The *lumbricales* (fig. 134,[4],[4]) are four small tapering muscles, in form like worms, whence their name is derived. They *arise* from the tendons of the flexor communis digitorum at their point of division, and each is attached to two tendons with the exception of the most internal ; thence they pass forwards to the inner side of the four smaller toes, where each ends in a thin tendon, and being united with the base of the first phalanx at the inner border, is *inserted* into the tendinous expansion of the extensor muscles on the dorsal surface of the digit. Lumbricales. Origin. Insertion.

These little muscles are less distinct than those of the hand. They are liable to the same variations of arrangement.

Dissection.—Cut the flexor tendons across, detach the flexor accessorius from its origin, and draw them forwards or over the sides of the foot. When these muscles are removed, the third layer is laid bare, filling up the deep irregular part of the sole of the foot. Dissection of third layer.

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* The muscles of the plantar surface of the foot, after removal of the superficial series. 1. Tendon of the long flexor of the great toe. 2. Tendon of the long flexor of the toes. 3. Flexor accessorius. 4. Lumbricales. 5. Tendon of the short flexor of the toes. 6. Short flexor of the great toe. 7. Short flexor of the little toe.

† "In Hippocratis et Galeni Physiologiæ partem Anatomicam Isagoge a Jacobo Sylvio."—Cap. vii. Venet. 1556.

Flexor brevis pollicis.

Flexor brevis pollicis pedis (fig. 135,[1]).—The short flexor of the great toe is single and pointed behind, but divided into two parts or heads in front. It

Origin.

arises by a flat tendinous process, which extends along a great part of the upper surface, from the inner border of the cuboid bone, and from the tendinous band sent to the cuneiform bones from the tendon of the tibialis posticus. These origins can be best perceived when the muscle is cut across and detached carefully from before backwards. The fleshy mass divides into two parts, which are inserted, one into the inner, the other into the external border of the base of the first phalanx of the great toe; each head is also intimately connected with one of the sesamoid bones beneath the articulation. Moreover, before reaching its points of insertion, an intimate union is established between this muscle and the abductor pollicis on the one side, and the adductor on the other. The tendon of the flexor longus runs along the interval between the heads of the short flexor.

Fig. 135.*

Insertion in two parts, one on each side of first phalanx.

Sesamoid bones in tendons.

Connected with abductor and adductor.

Flexor longus between.

Adductor pollicis.

Adductor pollicis pedis (fig. 135,[2]).—The adductor of the great toe is placed obliquely in the sole of the foot, forming a short, thick, fleshy mass. It *arises* from the tarsal extremity

Origin.

of the third and fourth metatarsal bones, and from the sheath of the peroneus longus muscle[7]; it is directed obliquely inwards and is *inserted*, conjointly with the external head of the flexor brevis pollicis, into the base of the first phalanx of the great toe.

Inserted with flexor brevis.

The adductor of the great toe and the short flexor are thus found to be intimately united at their insertion; and if they be cut across about an inch behind the first joint, and reflected forwards, two small sesamoid bones will be found connected with their tendons, just as the patella is with the extensor tendon of the knee-joint. Like the patella, one of

Sesamoid bones.

* A view of deeper muscles than those shown in the preceding figure. 1. Short flexor of the great toe. 2. Adductor of the great toe. 3. Transversus pedis. 4. Short flexor of the little toe. 5, 6. Interosseous muscles. 7. Tendon of peroneus longus. 8. Ligamentum longum plantæ.

the osseous surfaces is smooth, and enters into the composition of the articulation, being lined by the synovial membrane; and, like it, the sesamoid bone is developed in the substance of the tendons to increase the power of action.

Transversalis pedis; beneath joints of phalanges with metatarsus.

The *transversus pedis* (fig. 135,[3]) is a narrow fasciculus of fleshy fibres, stretched beneath the digital extremities of the metatarsal bones, being interposed between them and the flexor tendons. Its outer extremity is attached usually to the lateral ligament connecting the fifth metatarsal bone with the first phalanx of the little toe; but oftentimes it commences at the fourth. The muscle passes from without inwards, its fibres being connected with the heads of the fourth, third, and second metatarsal bones, or rather with the ligaments connecting them with the phalanges. It thus reaches the ball of the great toe, where it becomes blended with the fibres of the adductor pollicis.

Flexor minimi digiti.

Flexor brevis minimi digiti pedis (fig. 135,[4]; 134,[7]).— The short flexor of the little toe is placed at the external side of the sole of the foot.

Origin.

Arising by tendon from the base of the fifth metatarsal bone, and from the sheath of the peroneus longus, the fleshy fibres terminate in a tendon which

Insertion.

is *inserted* into the base and external border of the first phalanx of the little toe. The deep surface of this muscle is in contact with the fifth metatarsal bone; the superficial is covered partly by the abductor minimi digiti, partly by the plantar fascia.

Fig. 136.*

Interossei; two sets;

The *interosseous* muscles (interossei), as their name implies, are placed between the metatarsal bones, filling up the intervening spaces. There are seven in all, and they are divided into two sets, which differ from one another in their position and arrangement. On the *dorsal* aspect of the metatarsus four of the muscles are perceptible, and they are named from this circumstance. The other set are recognisable only on the *plantar* surface, and they are named

* The bones of the foot, with the dorsal interosseous muscles, seen from above.

named numerically. accordingly. The sets of the interosseous muscles are distinguished numerically from within outwards, like the spaces which they occupy.

Dorsal interosseous; each arises from two bones. *a.*—The *dorsal interosseous* muscles (fig. 136) closely resemble one another in appearance, structure, and attachment. Their fibres arise from the contiguous surfaces of the two bones between which they lie, and pass obliquely forwards to a slight tendon that runs along the centre of each, so that they form a penniform muscle. Their posterior extremities are bifid, having angular intervals, occupied by the perforating branches which pass from the plantar to the dorsal arteries. These muscles dip down into the sole of the foot, where the plantar series are altogether placed; hence it is that, in this latter situation, their appearance and arrangement are somewhat complicated (fig. 135).

Artery in notch at hinder end.

First and second. The first *two* dorsal interosseous muscles belong to the second toe, being inserted, the one (fig. 136,[1]) into the internal, the other[2] into the external side of its first phalanx, and into the margins of the extensor tendon as this expands upon the dorsal surface. The dorsal artery of the foot passes through the angular interval at the posterior end of the first, as it courses downwards to join the plantar artery.—The *third* dorsal muscle[3] is inserted into the external side of the first phalanx of the third toe.—And the *fourth*[4] terminates in like manner on the first phalanx of the fourth toe.

Third.

Fig. 137.*

Plantar set. *b.*—The *plantar interosseous* muscles are not, strictly speaking, situate between the metatarsal bones; they are placed rather beneath the third, fourth, and fifth metatarsal bones, inclining somewhat towards their inner borders. These are single muscles, and are connected each with but one metatarsal bone.

First plantar; The *first* plantar interosseous muscle (fig. 137,[1]) arises along the inner border of the third metatarsal bone. The fleshy fibres end in a

* The bones and ligaments of the foot seen on the plantar aspect, with the plantar interosseous muscles.

tendon, which is inserted into the base of the first phalanx of the same (third) toe, becoming blended with the tendinous expansion of the extensor communis.

The *second* plantar interosseous muscle [2] arises from the inner side of the fourth metatarsal bone, and is inserted into the inner border of the first phalanx of the corresponding toe, as well as into the extensor tendon. second;

The *third* plantar interosseous muscle [3] arises from the inner side of the fifth metatarsal bone, and is inserted into the base of the first phalanx of the little toe, and into the extensor tendon. third.

From the foregoing description it appears that the interosseous muscles now examined correspond with those of the hand, with the exception that,—while the latter are so disposed as to abduct the fingers from, or adduct them towards a line running through the *centre of the middle finger*,—the dorsal muscles of the foot are calculated to move the toes from the *middle of the second toe*, and the plantar series to incline them towards that point. The dorsal muscles therefore increase the breadth of the foot; and the plantar muscles lessen it, or restore the toes to the position from which they are removed by the former set. Actions of interosseous muscles; referred to middle of second toe.

TABLE OF THE MUSCLES

IN THE ORDER OF DISSECTION.

In the head and neck there are sixty six muscles at each side, which are disposed in sets or groups in parts technically termed regions. They may be dissected in the following order. When a muscle is contained in two regions it is enumerated in each, but is included within brackets ( ).

MUSCLES OF THE HEAD AND NECK.

Epicranial Region.

Occipito-frontalis.

Auricular Region.

Attollens aurem.
Retrahens aurem.
Attrahens aurem.

MUSCLES OF THE EYE-LIDS AND ORBIT.

Palpebral Region.

Orbicularis palpebrarum.
Corrugator supercilii.
(Levator palpebræ.)
(Tensor tarsi.)

Orbital Region.

Rectus superior.
——— inferior.
——— internus.
——— externus.
Obliquus superior.
——— inferior.
Levator palpebræ.
Tensor tarsi.

MUSCLES OF THE FACE.

Nasal Region.

Pyramidalis nasi.
Compressor naris.
Levator labii superioris alæque nasi.
Depressor alæ nasi.
Levator prop. alæ nasi posterior.
——— ——— anterior.

Superior Maxillary Region.

Levator labii superioris.
——— anguli oris.
Zygomaticus major.
——— minor.

Inferior Maxillary Region.

Triangularis oris.
Depressor labii inferioris.
Levator labii inferioris.

Inter-maxillary Region.

Buccinator.
Risorius.
Orbicularis.

Temporo-maxillary Region.

Masseter.
Temporalis.

Pterygo-maxillary Region.

Pterygoideus internus.
——— externus.

MUSCLES OF THE NECK.

Superficial Region.

Platysma myoides.
Sterno-cleido-mastoideus.
(Rectus sternalis.)

Sterno-hyoid Region.

Sterno-hyoideus.
Sterno-thyroideus.
Thyro-hyoideus.
Crico-thyroideus.
Omo-hyoideus.

Sub-maxillary Region.

Digastricus.
Stylo-hyoideus.
——— ——— alter.
Stylo-glossus.
Stylo-pharyngeus.

Genio-hyoid Region.

Mylo-hyoideus.
Genio-hyoideus.
Hyo-glossus.
Genio-hyo-glossus.

Muscles of the Pharynx.

Constrictor inferior.
——— medius.
——— superior.
(Salpingo-pharyngeus.)
(Stylo-pharyngeus.)
(Palato-pharyngeus.)

Muscles of the soft Palate.

Levator palati.
Circumflexus palati.
Azygos uvulæ.
Palato-glossus.
(Palato-pharyngeus.)

Muscles of the Larynx.

(Crico-thyroideus.)
Crico-arytænoideus posticus.
Crico-arytænoideus lateralis.
Thyro-arytænoideus.
Arytænoideus.
Arytæno-epiglottideus.
Thyro-epiglottideus.

Vertebral Region, lateral.

Scalenus anticus.
——— medius.
——— posticus.
——— minimus.
——— lateralis.

Vertebral Region, anterior.

Rectus capitis anticus major.
——— ——— minor.
Rectus lateralis.
Longus colli.

MUSCLES OF THE UPPER EXTREMITY.

There are fifty three muscles in each limb (including the pectorales, subclavius, and serratus), which may be examined one after another, in the order here set down.

Anterior Thoracic Region.

Pectoralis major.
——— minor.
Subclavius.
(Rectus sternalis.)

Lateral Thoracic Region.

Serratus magnus.

MUSCLES OF THE SHOULDER.

Acromial Region.

Deltoideus.

Scapular Region, posterior.

Supra-spinatus.
Infra-spinatus.
Teres minor.
—— major.

Scapular Region, anterior.

Sub-scapularis.

MUSCLES OF THE ARM.

Humeral Region.

Coraco-brachialis.
Biceps flexor cubiti.
Brachialis anticus.
Triceps extensor cubiti.
Sub-anconeus.

MUSCLES OF THE FOREARM.

Brachial Region, inner and anterior.

Pronator radii teres.
Flexor carpi radialis.
Palmaris longus.
Flexor carpi ulnaris.
—— digitorum sublimis.
—— ——— profundus.
(Lumbricales.)
Flexor pollicis longus.
Pronator quadratus.

Radial Region.

Supinator radii longus.
Extensor carpi radialis longior.
——— ——— brevior.
Supinator radii brevis.

Brachial Region, posterior.

Anconeus.
Extensor digitorum communis.
——— minimi digiti.
——— carpi ulnaris.
——— ossis metacarpi pollicis.
——— primi internodii pollicis.
——— secundi internodii pollicis.
——— indicis.

MUSCLES OF THE HAND.

Palmar Region.

Abductor pollicis.
Opponens pollicis.
Flexor brevis pollicis.
Adductor pollicis.
Palmaris brevis.
Abductor minimi digiti.
Flexor brevis minimi digiti.
Adductor minimi digiti.
Lumbricales.
Inter-ossei.

MUSCLES OF THE TRUNK.

Omitting the pectorales, subclavius, and serratus magnus, which are usually taken with the upper extremity, in the trunk of the body there are ninety muscles at each side, together with the diaphragm and levator ani, which are single.

MUSCLES OF THE ABDOMEN.

Abdominal Region.

Obliquus externus abdominis.
——— internus.
Cremaster.
Transversalis.
Rectus abdominis.
Pyramidalis.
Quadratus lumborum.

MUSCLES OF THE THORAX.

Anterior Thoracic Region.

(Pectoralis major.)
(Pectoralis minor.)
(Subclavius.)

Lateral Thoracic Region.

(Serratus magnus.)

Costal Region.

Inter-costales [externi, interni.]
Infra-costales.
Levatores costarum.
Triangularis sterni.
Diaphragma.

MUSCLES OF THE PELVIS AND PERINÆUM.

Iliac Region.

Psoas magnus.
—— parvus.
Iliacus.

Perinæal Region.

Sphincter ani.
Transversus perinæi.
Accelerator urinæ.
Erector penis.
Levator ani.
Coccygeus.
Compressor urethræ.
(Erector clitoridis.
Constrictor vaginæ.)

MUSCLES OF THE BACK.

These are arranged in layers.

Dorsal Region.

1. Trapezius.
Latissimus dorsi.

2. Levator anguli scapulæ.
Rhomboideus minor.
——— major.

3. Serratus posticus superior.
——— ——— inferior.
Splenius colli.
——— capitis.

4. Erector spinæ.
Sacro-lumbalis.
Cervicalis descendens.
Accessorius ad sacro-lumbalem.
Longissimus dorsi.
Transversalis cervicis.
Trachelo-mastoideus.
Spinalis dorsi.
——— cervicis.
Complexus.
Biventer cervicis.

5. Semi-spinalis dorsi.
Semi-spinalis colli.
Inter-spinales.
Inter-transversales.
Inter-accessorii.
Multifidus spinæ.
Rotatores spinæ.
Extensores coccygis.
(Levatores costarum.)

Rectus capitis posticus major.
——— ——— minor.
Obliquus capitis superior.
——— ——— inferior.

MUSCLES OF THE LOWER EXTREMITY.

In each limb are fifty six muscles, which may be dissected in the following order.

MUSCLES OF THE THIGH.

Femoral Region, anterior.

Tensor vaginæ femoris.
Sartorius.
Rectus.
Crureus.
Sub-crureus.
Vastus externus.
—— internus.

Femoral Region, internal.

Gracilis.
Pectineus.
Adductor longus.
——— brevis.
——— magnus.

Gluteal Region, superficial.

Gluteus maximus.
——— medius.
——— minimus.

Gluteal Region, deep-seated.

Pyriformis.
Gemellus superior.
Obturator internus.
Gemellus inferior.
Quadratus femoris.
Obturator externus.

Femoral Region, posterior.

Biceps femoris.
Semi-tendinosus.
Semi-membranosus.

MUSCLES OF THE LEG.

Tibio-fibular Region, anterior.

Tibialis anticus.
Extensor pollicis.
——— digitorum longus.
Peroneus tertius.
(Extensor digitorum brevis.)
Peroneus longus.
——— brevis.

Tibio-fibular Region, posterior superficial.

Gastrocnemius.
Plantaris.
Soleus.

Deep-seated.

Popliteus.
Flexor longus digitorum pedis.
——— ——— pollicis pedis.
Tibialis posticus.

MUSCLES OF THE FOOT.

Dorsal Region.

Extensor digitorum brevis.

Plantar Region.

Abductor pollicis.
Flexor brevis digitorum.
Abductor digiti minimi.

Flexor accessorius.
Lumbricales.

Flexor brevis pollicis.
Adductor pollicis.
Flexor brevis digiti minimi.

Transversus pedis.
Inter-ossei.

TABLE OF THE MUSCLES,

ARRANGED AFTER THE MANNER OF DR. BARCLAY, ACCORDING TO THEIR ACTIONS.

THE HEAD IS MOVED

Forwards by

Platysma myoides
Sterno-mastoideus
Rectus anticus major
——— minor,

Assisted (when the lower jaw is fixed) by

Mylo-hyoideus
Genio-hyoideus
Genio-hyo-glossus
Digastrici.

Backwards by

Part of trapezius
Splenius capitis
Complexus
Trachelo-mastoideus
Rectus posticus major
——— minor
Obliquus capitis superior.

To either side by

Platysma myoides
Sterno-mastoideus
Part of trapezius
Splenius capitis
——— colli
Trachelo-mastoideus
Complexus.

THE NECK IS MOVED

Forwards by

Platysma myoides
Sterno-mastoideus
Digastricus
Mylo-hyoideus
Genio-hyoideus
Genio-hyo-glossus
Omo-hyoidei
Sterno-hyoidei
Thyro-hyoidei
Rectus anticus minor
Longus colli.

Backwards by

Part of trapezius
Rhomboideus minor
Serratus posticus superior
Splenius capitis
——— colli
Complexus
Trachelo-mastoideus
Transversalis colli
Inter-spinales colli
Semi-spinales colli
Rectus posticus major
——— minor
Obliquus capitis superior
——— inferior
Scaleni postici
Levator scapulæ.

Laterally by

Various combinations of those muscles which separately move it forwards and backwards, assisted by the scaleni, inter-transversales, and recti-laterales.

THE TRUNK IS MOVED

Forwards by

Rectus abdominis
Pyramidalis
Obliquus externus abdominis
Obliquus internus
Psoas magnus
—— parvus,

Assisted (when the arms are carried forwards) by

Pectoralis major
——— minor
Serratus magnus.

Backwards by

Trapezius
Rhomboideus major
Latissimus dorsi
Serratus posticus superior
——— inferior
Sacro-lumbalis
Longissimus dorsi
Spinales dorsi
Semi-spinales dorsi
Multifidus spinæ
Inter-transversales dorsi et lumborum.

Laterally by

Obliquus externus
——— internus
Quadratus lumborum
Longissimus dorsi
Sacro-lumbalis
Serrati postici
Latissimus dorsi.

THE SCAPULA IS MOVED

Upwards by

Trapezius
Levator scapulæ
Rhomboidei.

Downwards by

Lower part of trapezius
Latissimus dorsi
Pectoralis minor.

Forwards by

Pectoralis minor
Serratus magnus.

Backwards by

Part of trapezius
Rhomboidei
Latissimus dorsi.

THE HUMERUS IS MOVED

Forwards by	*Backwards by*	*Inwards by*	*Rotated inwards by*
Part of deltoid Part of pectoralis, major, *Assisted in some circumstances by* Biceps Coraco-brachialis.	Part of deltoid Teres major —— minor Long head of triceps Latissimus dorsi.	Part of pectoralis major Latissimus dorsi.	Subscapularis, *Assisted occasionally by* Pectoralis major Latissimus and teres major. *Outwards by* Supra-spinatus Infra-spinatus Teres minor.

THE FOREARM IS MOVED

Forwards by	*Backwards by*	*Rotated inwards by*
Biceps Brachialis anticus Pronator teres, *Assisted by* Flexor carpi radialis —— sublimis —— ulnaris Supinator longus.	Triceps Anconeus.	Pronator teres Flexor carpi radialis Palmaris longus Flexor sublimis Pronator quadratus. *Outwards by* Biceps Supinator brevis Extensor secundi internodii.

THE CARPUS IS MOVED

Forwards by	*Backwards by*	*Outwards by*	*Inwards by*
Flexor carpi radialis Palmaris longus Flexor sublimis —— carpi ulnaris —— profundus —— longus pollicis.	Extensor carpi radialis longior. Extensor carpi radialis brevior Extensor secundi internodii Indicator Extensor communis digitorum —— proprius pollicis.	Flexor carpi radialis Extensor carpi radialis longior Extensor carpi radialis brevior Extensor ossi metacarpi Extensor primi internodii.	Flexor sublimis —— carpi ulnaris —— profundus Extensor communis digitorum —— minimi digiti —— carpi ulnaris.

THE THUMB IS MOVED

Inwards and forwards, across the palm, by	*Outwards and backwards by*	*Upwards and forwards, away from the other fingers, by*	*Backwards and inwards to the other fingers, by*
Opponens pollicis Flexor brevis —— longus.	Extensor ossis metacarpi pollicis Extensor primi internodii Extensor secundi internodii.	Abductor, *Assisted by part of the* Flexor brevis.	Adductor Extensor primi internodii Extensor secundi internodii.

THE FINGERS ARE MOVED

Forwards, or flexed, by	*Backwards, or extended, by*	*Outwards, to radial border, by*	*Inwards by*
Flexor sublimis —— profundus Lumbricales Interossei Flexor brevis digiti minimi Abductor digiti minimi.	Extensor communis Extensor minimi digiti Indicator.	Abductor indicis Abductor digiti minimi Interossei.	Abductor digiti minimi. Interossei.

THE THIGH IS MOVED

Forwards by	*Backwards by*	*Inwards by*	*Outwards by*
Psoas magnus Iliacus Tensor vaginæ femoris Pectineus Adductor longus ——— brevis.	Gluteus maximus Part of gluteus medius Pyriformis Obturator internus Part of adductor magnus Long head of biceps Semi-tendinosus Semi-membranosus.	Psoas magnus Iliacus Pectineus Gracilis Adductor longus ——— brevis ——— magnus Obturator externus Quadratus femoris.	Tensor vaginæ femoris Gluteus maximus ——— medius ——— minimus Pyriformis.

THE THIGH IS ROTATED		THE LEG IS MOVED	
Inwards by	*Outwards by*	*Backwards, or flexed, by*	*Extended by*
Tensor vaginæ femoris Part of gluteus medius, *And, when the leg is extended, by* Sartorius Semi-tendinosus.	Gluteus maximus Part of gluteus medius Pyriformis Gemellus superior Obturator internus Gemellus inferior Quadratus femoris Obturator externus Psoas magnus Iliacus Adductor longus ——— brevis ——— magnus Biceps cruris, slightly.	Semi-tendinosus Biceps Semi-membranosus Gracilis Sartorius Popliteus.	Rectus Crureus Vastus externus ——— internus.

THE FOOT IS MOVED

Forwards, or flexed, by	*Backwards, or extended, by*	*Inclined inwards by*	*Outwards by*
Tibialis anticus Extensor proprius pollicis Extensor longus digitorum Peroneus tertius.	Gastrocnemius Plantaris Soleus Flexor longus digitorum Flexor longus pollicis Tibialis posticus Peroneus longus ——— brevis.	Extensor proprius pollicis Flexor longus digitorum Flexor longus pollicis. Tibialis posticus.	Peroneus longus ——— brevis Extensor longus digitorum Peroneus tertius.

THE TOES ARE MOVED

Backwards, or flexed, by	*Forwards, or extended, by*	*Inclined inwards*	*Outwards by*
Abductor pollicis Flexor brevis digitorum Abductor minimi digiti Flexor longus pollicis Flexor digitorum Flexor accessorius Lumbricales Flexor brevis pollicis Adductor pollicis Flexor minimi digiti Interossei.	Extensor longus digitorum Extensor proprius pollicis Extensor brevis digitorum.	Abductor pollicis Interossei.	Abductor pollicis ——— digiti minimi Interossei.

FASCIÆ.

THE fasciæ, composed ultimately of layers of whitish shining fibres arranged in a more or less reticular manner, and combined with dense connective tissue, constitute a series of comparatively inelastic and unyielding fibrous membranes, which invest and support the various soft parts entering into the construction of the trunk and limbs. Their nature;

Connected through the medium of the periosteum with certain parts of the skeleton, the fasciæ serve not only to encase individually, but to bind down collectively, and keep in place the muscles and their tendons. They vary much in thickness in certain situations, being thin and indistinct in some parts; while they become stronger and more defined in others, especially where from some cause, as in the sudden change in the direction of a tendon, there is more than usual danger of its displacement during muscular action. uses of.

Where flat muscles enclose certain large viscera (as on the abdomen), fasciæ form similar continuous expansions on their inner surface; and these also vary in their strength in different situations, as it were with the necessity for their existence.

By Bichat fasciæ have been named *aponeuroses of investment*, to distinguish them from proper tendinous expansions or *aponeuroses of insertion* (of muscles), of which the tendons of the occipito-frontalis and of the external abdominal muscles may be taken as examples. Practically however this distinction is not so absolute as it may, for systematic description, be convenient to assume, inasmuch as in both classes some aponeuroses are found to serve the double purpose of investment and insertion. Thus fasciæ are often observed, on the one hand, to give origin to muscular fibres, as illustrated in the gluteus medius and the muscles of the forearm; and on the other hand, to afford insertion to tendons, or to offsets from tendons passing in their immediate neighbourhood. Examples of the insertion of tendinous fibres into fasciæ are afforded by the gluteus maximus and the biceps brachialis. The connection between fasciæ and muscles is met with on the surface of the limbs, Aponeuroses of investment distinguished from those of insertion. Connection of fascia with muscles.

and more particularly over parts which undergo much change in figure during muscular action; and the effect of the arrangement would therefore appear to be,—in addition to its use in enlarging the extent of origin for muscular fibres, and in economising the osseous surface for the insertion of muscles,—to ensure a proper degree of tension in membranes which are not well fitted by their physical properties to accommodate themselves completely and accurately to such changes. Hence, also, in certain situations distinct muscles are provided for this especial purpose, as for example, the tensor of the fascia of the thigh (tensor vaginæ femoris), and that of the palmar fascia (palmaris longus).

Tensor muscles.

Connection with periosteum.

The connection between investing fasciæ and the periosteum is so intimate as to have induced Bichat to consider the periosteum as the centre of the aponeurotic system generally.*

Wherever a margin or surface of bone is unoccupied or uncovered by muscle or tendon, (*i. e.* where it is subcutaneous, as the spine of the tibia, or where it forms part of a large visceral cavity, as the brim of the pelvis,) the investing fascia is immediately connected with the periosteum, thus constituting a sort of septum, which would prevent the handle of a scalpel for example from being pushed freely under every part of what appears a continuous membrane.

Prolongations between muscles.

Where the bone lies at a considerable distance from the surface, the fasciæ are still freely connected with the periosteum through the medium of deep prolongations which pass between the muscles. Some of these, usually stronger than the rest, dip directly between separate groups of muscles, and are named *intermuscular septa;* as the intermuscular partitions of the thigh, which separating respectively the extensor, the adductor, and the flexor muscles of the limb, connect the fascia lata with the periosteum of the femur.

Complication of the layers of fasciæ.

In other situations, where the organs of various kinds are assembled together, and where the muscles are less clearly divided into parallel groups, as in the neck, these deeper processes of fascia have a much more complicated arrangement, being divided often so as to incase muscles, and occasionally strengthening the sheaths of important vessels.

* "Anatomie Générale," nouvelle édit. par Béclard et Blandin; Paris, 1830; t. 3, p. 209.

The complication is, in fact, a consequence of the multitude of the bodies held together by the fascia. In those parts which are frequently the seat of surgical operation, as the groin in consequence of the occurrence of hernia, some of these secondary processes of fascia have much interest for the practical surgeon, and are therefore deemed worthy of a careful description; but in other cases it is unnecessary to enter on any detailed description of them.

SUPERFICIAL FASCIÆ.

Under this name has been described another series of membranous coverings differing in strength, texture, appearance, connections, and uses, from those just alluded to, and allied to them only in the fact of their forming a general investment to the body and limbs. Superficial distinguished from true fascia.

Immediately beneath the skin, and between it and the true fascia, is found in most parts of the body an imperfectly membranous layer, composed of fibrous and connective tissues, which contains within its meshes a varying quantity of fat, and between its laminæ the superficial vessels and nerves as these course obliquely from under the deep or true fascia to enter the integument. Composition

The superficial fascia may be traced as a continuous covering over nearly the whole body. But, whilst in some parts, as in the groin, it is so thick as to be capable of subdivision into several layers by the knife; in others, as the palms of the hands, it is so closely united with the skin on the one aspect, and with the true fascia on the other, that it can scarcely be demonstrated. not equally thick over the whole body.

The principal use of the superficial fascia appears to be that of permitting a certain amount of motion between the elastic skin and the less yielding fascia beneath it, whilst it also unites those structures to each other. Uses.

In accordance with this view, it will generally be found that the structure in question is most distinct wherever the skin is loose and movable over the subjacent soft parts, as over the groin, the scrotum, and the anterior part of the perinæum; and that, where bursæ are superadded to facilitate this movement still farther, it is in the superficial fascia that they are developed. Where muscular fibres are directly inserted into, and act upon the skin, the superficial fascia is oftentimes so very thin, that it can hardly be said to exist. For example, over the superficial sphincter of the Very thin where muscles are attached to the skin.

anus, and the orbicularis palpebrarum, the muscular fibre so closely adheres to the under surface of the skin, that there is no substance intervening of sufficient importance to require description as an independent structure.

The superficial fascia is irregularly adherent on both its surfaces; but the only connections that it will be desirable farther to particularise are those which, in certain situations, it contracts with the true investing fasciæ.

Having thus pointed out the distinction between superficial and true fasciæ, it will be more convenient to examine them together as they exist in different parts of the body, than to treat of them under separate and independent heads.

FASCIÆ OF THE HEAD AND NECK.

Superficial fascia of the head.

The *superficial fascia* is not largely developed on the head and neck. Over the upper and fore part of the cranium it is a dense firm layer that adheres closely to the skin, and to the occipito-frontalis and the epicranial aponeurosis. Over the occipital portion of this muscle the superficial fascia is continuous with that covering the back of the neck; and on either side of the epicranial aponeurosis it descends over the temporal fascia, and contains between its laminæ the external muscles of the ear, with the superficial temporal vessels and nerves.

Of the face.

In the face the muscular fibres are so frequently inserted into the skin, that in several spots there is no intervening layer worthy the name of a continuous membrane; and over most of the face the fatty substance is in excess.

Of the side of the neck.

On the side of the neck, where the representative of the superficial fascia is found in the tissue around the platysma myoides muscle, it is thin, and in it the external jugular vein and some superficial branches of nerves are contained.

Deep fasciæ of the neck.

Deep fasciæ.—The chief fasciæ of the head and neck belong therefore to the proper investing class; and owing to the arrangement of the muscles in the neck, and the presence of several important parts in a small space (*e. g.* vessels, nerves, glands, the windpipe, &c.), the subdivisions and attachments of these membranes are proportionally complicated.

Temporal fascia;

The *temporal fascia* has been already described (p. 19.), in connection with the muscle of the same name, to which it

affords an extensive origin. Single above, where it is fixed to the curved margin of the temporal fossa, it divides below into two layers, one of which is attached to the outer and the other to the inner surface of the zygoma; and in this situation there is deposited between its layers a quantity of fat, the absorption of which assists in giving the hollowness to the temples of those who have suffered from illness of long standing. This dense fascia is separated from the teguments by the layer of thin membrane descending from the epicranial aponeurosis, and by the small muscles of the pinna of the ear; and from the temporal muscle below, by another layer of fat. **fixed to bone.**

Parotid fascia.—The fascia covering the parotid gland might not inaptly be considered a portion of, or an elongation from the cervical fascia. From the lower margin of the zygoma a strong layer of fascia descends over the parotid gland. Below it is continuous with the deep fascia of the neck; behind it attaches itself firmly to the cartilaginous portion of the external meatus of the ear (particularly on the lower aspect), and afterwards continues over the mastoid process and the upper portion of the sterno-mastoid muscle; in front the membrane gradually dwindles over the masseter muscle, where it has been sometimes named the *masseteric fascia.* **Investment of parotid gland, continued into cervical fascia.**

On the inner or deeper surface of the parotid a similar though weaker membrane exists; and along its anterior margin the two, uniting together, complete the proper investment of the gland, with the vessels and nerves passing through it, and likewise encase the socia parotidis and Stenson's duct.

The *cervical fascia* (named also proper or deep cervical), when fully laid bare by removing the platysma myoides, is seen to form one continuous sheath to the neck. Commencing with the thinnest and weakest part at the back of the neck, it is attached to the spinous processes of the cervical vertebræ and to the ligamentum nuchæ, whence it extends forwards to the sterno-mastoid muscle. Here the fascia separates into two layers, one of which covering the cutaneous surface of the muscle last named appears on a superficial dissection, whilst the other passing on the deeper aspect has additional connections, hereafter to be examined. After thus encasing the sterno-mastoid, these layers reunite along the anterior margin of the muscle; and the single membrane thus formed stretches to the middle line in front, **Cervical fascia; a continuous sheath to the neck; encases sterno-mastoid.**

where it is continuous with the part of the fascia covering the opposite side of the neck. The connections of the continuous sheath thus given to the entire neck will first be followed out, and then the deeper processes sent between the muscles will be proceeded with.

Connections above; When traced upwards, the layer of fascia on the cutaneous surface of the sterno-mastoid is continuous in front of the ear with the fascia covering the parotid gland and the masseter muscle, and still farther forwards is attached to the base of the lower jaw. Followed downwards, it is continued on the sterno-mastoid to the clavicle and sternum. Behind that muscle the fascia is pierced, near the clavicle, by the external jugular vein hitherto superficial to the membrane. In front, the fascia is comparatively thin above, where it is fixed to the hyoid bone; but, becoming stronger as it descends, it splits, a little below the level of the thyroid body, into two distinct layers. Of these the more superficial and weaker, guided by the sterno-mastoid muscles, is fixed to the sternum, and the interclavicular ligament; whilst the stronger layer, lying under the former, and closely covering the sterno-hyoid and sterno-thyroid muscles, is attached to the deeper surface of that bone. These layers materially assist in closing the cavity of the chest, above the sternum; and between them there exists a quantity of loose connective tissue and fat, with sometimes a small lymphatic gland.

in front.

Arrangement above the sternum.

Closes the chest.

Deep processes; The processes of cervical fascia which dip between the muscles of the neck, and remain to be followed, may be said to be continued from the deeper of the two layers already alluded to as enclosing the sterno-mastoid muscle. A process of the fascia of considerable density, extending upwards behind and to the inner side of the parotid gland, is fixed to the styloid process and the ramus of the lower maxilla, and is known under the name of the *stylo-maxillary ligament*. (See vol. i. p. 197.) Downwards, and a little outwards, another strong portion of the fascia encloses the posterior half of the omo-hyoid, binding it down and maintaining the angular direction of the muscle; this portion of the fascia descends to be inserted into the clavicle and the inner part of the first rib.

upwards.

Stylo-maxillary ligament.

Downwards connected with omo-hyoid;

with sheath of vessels. Another and somewhat irregular process of the fascia assists in forming the *common sheath of the large cervical blood-vessels* (the carotid artery and jugular vein, with the pneumo-gastric nerve), a thin fibrous septum intervening

between the two vessels, and thus completing a separate sheath for each.

Lastly, a thin membranous partition is continued inwards across the trachea and thyroid body (to which latter it sends an investment), and immediately behind the sterno-thyroid muscles. This layer has been traced, over the large vessels at the root of the neck, to the fibrous layer of the pericardium.* Inwards, covers trachea and thyroid body.

Interposed between the pharynx and the muscles immediately applied to the fore part of the vertebral column is another layer of the general fascia of the neck, known as the *prevertebral fascia.* Attached to the basilar process of the occipital bone, and on each side to the transverse processes (parapophyses) of the vertebræ this layer immediately covers the rectus capitis anticus and lateralis, and the longus colli muscles, and it is likewise expanded over the scaleni muscles and the cervical nerves. Prevertebral fascia.

FASCIÆ OF THE THORAX.

The *superficial fascia* covering the thorax, continuous with that of the neck and the upper limb above, and with that of the abdomen below, is loose and distinct over the greater part of the surface of the chest. In the neighbourhood of the mamma this membrane divides into two layers, which enclose the gland, one lying before, the other behind it. From both these layers offsets are continued into the glandular substance, separating it into parts and supporting these. The posterior layer is likewise connected with the immediate investment of the pectoral muscle by bands of a similar kind; and processes containing between them masses of fat are extended from the anterior lamina forward to the skin and the nipple. From the support they afford to the mammary gland, and the connection they establish between Superficial fascia. Encloses mamma.

* Godman, having traced the cervical fascia into the pericardium, strongly insisted on considering the fibrous investment of the heart as *formed from* the fascia; but from this mode of expression, which is often met with in anatomical language, no more should be understood than the mere fact of continuity, for, on the same grounds, the pericardium might as well be said to form the cervical fascia. In some instances Mr. Quain has failed to trace the continuity of the two structures, in consequence of the fascia degenerating (as it often does in other places) into mere connective tissue at some distance from the upper end of the pericardium. See "Anatomical Investigations, by John Godman, M.D." Philadelphia, 1824.

where it is continuous with the part of the fascia covering the opposite side of the neck. The connections of the continuous sheath thus given to the entire neck will first be followed out, and then the deeper processes sent between the muscles will be proceeded with.

Connections above; When traced upwards, the layer of fascia on the cutaneous surface of the sterno-mastoid is continuous in front of the ear with the fascia covering the parotid gland and the masseter muscle, and still farther forwards is attached to the base of the lower jaw. Followed downwards, it is continued on the sterno-mastoid to the clavicle and sternum. Behind that muscle the fascia is pierced, near the clavicle, by the external jugular vein hitherto superficial to the membrane. In front, the fascia is comparatively thin above, where it is fixed to the hyoid bone; but, becoming stronger as it descends, it splits, a little below the level of the thyroid body, into two distinct layers. Of these the more superficial and weaker, guided by the sterno-mastoid muscles, is fixed to the sternum, and the interclavicular ligament; whilst the stronger layer, lying under the former, and closely covering the sterno-hyoid and sterno-thyroid muscles, is attached to the deeper surface of that bone. These layers materially assist in closing the cavity of the chest, above the sternum; and between them there exists a quantity of loose connective tissue and fat, with sometimes a small lymphatic gland.

in front.

Arrangement above the sternum.

Closes the chest.

Deep processes; The processes of cervical fascia which dip between the muscles of the neck, and remain to be followed, may be said to be continued from the deeper of the two layers already alluded to as enclosing the sterno-mastoid muscle. A process of the fascia of considerable density, extending upwards behind and to the inner side of the parotid gland, is fixed to the styloid process and the ramus of the lower maxilla, and is known under the name of the *stylo-maxillary ligament*. (See vol. i. p. 197.) Downwards, and a little outwards, another strong portion of the fascia encloses the posterior half of the omo-hyoid, binding it down and maintaining the angular direction of the muscle; this portion of the fascia descends to be inserted into the clavicle and the inner part of the first rib.

upwards.

Stylo-maxillary ligament.

Downwards connected with omo-hyoid;

with sheath of vessels. Another and somewhat irregular process of the fascia assists in forming the *common sheath of the large cervical blood-vessels* (the carotid artery and jugular vein, with the pneumo-gastric nerve), a thin fibrous septum intervening

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it and the skin and nipple, the last-mentioned processes were named by Sir A. Cooper the "ligamenta suspensoria"* of the organ they serve to support. The superficial fascia covering the thorax is thinner and denser, and contains less fat near the middle line in front.

Deep fascia of the thorax.

The *deeper fascia* of the thorax, firmly adherent to the surface of the sternum, and to the clavicle under the platysma myoides, is thin and weak over the upper part of the pectoral muscle, to which it is connected through the medium of fine elongations extended between the fasciculi of muscular fibres. It becomes somewhat stronger in the interval between the margins of the pectoralis major and latissimus dorsi muscles, where it closes in the axillary space; and is most developed near the epigastric region, where it is intimately united with the dense aponeurotic fibres covering the upper part of the recti muscles. At the margin of the latissimus dorsi the fascia splits, one layer continuing on the cutaneous, the other on the deep aspect of that muscle; and both layers become attached to the spines of the dorsal vertebræ.

Under pectoral muscles.

By reflecting the great pectoral muscle a deep layer of fascia is brought into view, which is strongest at the upper and outer part, where it is stretched between bones, but becomes weaker in front of and behind the smaller pectoral muscle. The upper and stronger portion of this deep layer of fascia is named the *costo-coracoid ligament* or membrane.

Costo-coracoid membrane.

The fibres of this structure are aggregated together on the outer side, and are here inserted into the coracoid process of the scapula, and join the fascia of the arm; from this point they diverge upwards and inwards, becoming proportionally weaker, and are attached above along the under margin of the clavicle and to the inner extremity of the first rib. The band thus formed stretches across and protects the axillary vessels and nerves, and offers considerable resistance to the finger pressed between the coracoid process of the scapula and the clavicle. It does not present any defined margin, in consequence of its elongation downwards to join the loose sheath of the axillary vessels and nerves, and in consequence of its continuity with the thinner membrane already noticed as descending to the pectoralis minor. Lastly a thinner layer, passing behind the subclavius, completes the investment for that muscle, being fixed to the bone behind it.

* "On the Anatomy of the Breast." London, 1840.

Intercostal fasciæ.—On the cutaneous surface of the external intercostal, and on the inner aspect of the internal intercostal muscle, exist distinct and firm though thin layers of fascia; and there is also a delicate stratum between the two sets of muscles. These layers of fascia become much stronger at the points at which the corresponding muscles are deficient; namely, between the external inter-costal muscle and the sternum in front, and between the internal inter-costals and the vertebral column behind. Intercostal fasciæ.

The *vertebral aponeurosis*, which might be enumerated amongst the fasciæ of the thorax, has been described at page 59, in connection with the muscles it separates. Vertebral aponeurosis.

FASCIÆ OF THE UPPER LIMB.

The *superficial fascia* of the arm requires but little notice. It is most distinct opposite the bend of the elbow, where the superficial veins, contained within its laminæ, are numerous and large. In the palm of the hand, on the contrary, it is so adherent to the skin and true palmar fascia, or rather these two structures are here so connected by dense fibrous bands, that it is impossible to demonstrate the existence of superficial fascia as a separate layer. Subcutaneous bursæ are usually found in this fascia over the acromion, the olecranon, and the knuckles. Superficial fascia.

The *deep fascia* over the greater part *of the deltoid* is coarse and fibrous, adhering closely to the surface of the muscle, and continuous with the septa which dip between its fasciculi. Over that portion of the muscle which arises posteriorly from the spine of the scapula, the fascia becomes more dense, and descends to join with that investing the infraspinatus and the back of the arm. Fascia of the shoulder.

The *fascia of the arm*, composed chiefly of transverse fibres held together by others having an oblique or longitudinal course, differs much in density at different parts. Thus it is thin over the biceps muscle, stronger where it covers the triceps, and particularly dense as it approaches the outer and inner condyles of the humerus. It is strengthened above, and during muscular action is kept tense, by tendinous fibres prolonged from the pectoralis major and latissimus dorsi on the inner side, and from the deltoid on the outer side. The fascia of the arm may be considered as a continuation downwards of the fascia already described as covering these several muscles. Fascia of the arm.

Inter-muscular septa; This fascia is connected to the shaft and condyles of the humerus by two processes, which extend directly to the bone, and, separating the muscles on the posterior from those on the anterior aspect of the limb, are named *intermuscular septa*. external; Of these the *external*, which is not well marked, reaches from the insertion of the deltoid, along the outer ridge on the shaft of the humerus to the external condyle. It receives tendinous fibres from the deltoid, and gives partial origin to the muscles between which it is interposed, namely, the triceps behind, and the supinator longus and extensor carpi radialis longior in front. It is pierced from behind forwards by the musculo-spiral nerve and the superior profunda artery. internal. The *internal* septum, much thicker and stronger than the other, begins near the insertion of the coraco-brachialis, from which it receives fibres; it extends between the triceps and brachialis anticus, affording points of attachment to some of the fibres of these muscles. It is traversed from before backwards by the ulnar nerve and the lower profunda and anastomotic arteries. Besides these septa, the fascia of the arm sends thinner offsets to separate the different muscles from each other (as the biceps from the brachialis anticus), and to assist in forming the sheath for the brachial vessels and median nerve.

Fascia of the fore arm; The *fascia of the fore arm*, continuous above with that descending from the upper arm, is closely connected at the at bend of elbow. bend of the elbow with the periosteum covering the superficial portion of the condyles of the humerus and the olecranon process of the ulna; and it is strengthened by tendinous fibres sent from the brachialis, and the triceps and biceps muscles. Below the elbow this fascia is composed principally of circular fibres attached to the olecranon, and the posterior margin of the ulna, crossed, however, by longitudinal and oblique fibres, which descend from the points of bone and tendons of muscles just indicated. Of these accessory fibres, the band sent from the biceps tendon (see Expansion from biceps. p. 84) is worthy of particular notice. It expands over the muscles arising from the inner condyle of the humerus; and it forms a firm though thin septum between the median basilic vein, which lies before it, and the brachial artery with its accompanying veins and median nerve, situate Connection with muscles. behind it. The fascia thus strengthened by the expansion from the biceps muscle is intimately connected with the muscles below the inner condyle of the humerus, giving origin to many of their fibres; and it is also united to the

fibrous bands (intermuscular septa) placed between those muscles, so that the muscles lie in separate cells or sheaths of fibrous structure.

The attachment of the fascia of the fore arm to the subcutaneous margin of the ulna conveniently divides it into an anterior and a posterior portion.

The *anterior* part of the fascia of the fore arm, continuing from that at the bend of the elbow, is much weaker than the membrane on the posterior aspect of the limb. In the hollow just below the bend of the elbow, this fascia presents a small oval aperture for the transmission of a short communicating branch between the superficial and the deep veins of the fore arm. It increases in density towards the hand; and a little above the wrist affords a sheath to the tendon of the long palmar muscle, which passes over the annular ligament to be inserted into the narrow end of the palmar fascia. Several white lines seen on the surface of the fascia mark the *intermuscular septa* which are continuous with it. Between the superficial and the deep layer of flexor muscles, another layer of fascia is stretched from side to side; it is stronger below than above, where it is generally little more than thin connective tissue. Anterior part.

The *anterior annular ligament* of the carpus, composed of close white fibres, extends transversely from the scaphoid and trapezium on the outer side, to the unciform and pisiform bones on the inner side, bridging over a space through which, sheathed by synovial membrane, run the tendons of the long flexor muscles of the digits, with the median nerve. The upper margin of this band is continuous with the fascia of the fore arm, and receives some fibres from the tendon of the flexor carpi ulnaris: the lower margin is connected with the palmar fascia, and gives origin partly to most of the short muscles of the thumb and little finger. The anterior surface is crossed by the tendon of the palmaris longus, by the ulnar artery and nerve, and by a cutaneous branch of the median nerve. The anterior annular ligament may be considered partly as a developed portion of the fascia of the wrist, and partly as a ligament. It is thicker, and more independent than the posterior annular ligament, because the flexors of the fingers are larger and more powerful than the extensors. Anterior annular ligament.

The *posterior portion* of the fascia of the fore arm, by far Fascia on

the back of fore arm. the thicker of the two, binds down the soft parts in the hollow between the bones of the fore arm, is intimately connected with the strong septa between the several superficial muscles, and sends off a thin nearly transverse membrane to separate the superficial from the deeper group of muscles. Approaching the back of the wrist, the transverse fibres increase in number and strength, and these being stretched from the outer margin of the radius on one side, to the cuneiform and pisiform bones and the palmar fascia on the other, constitute the *posterior annular ligament* of the carpus. (See vol. i. p. 217.) This structure is attached not only to the points just indicated, but is likewise connected to the several longitudinal ridges on the posterior surface of the radius, and thus converts the intermediate grooves into fibro-osseous canals to lodge the tendons of the extensor muscles. (Vol. i. p. 122.) There are six separate spaces under it, and each is lined by a distinct synovial sac.

Posterior annular ligament; several compartments.

Dorsal fascia of the hand. The *fasciæ of the hand.*—On the *dorsal* aspect is a thin layer of fascia, which is prolonged from the posterior annular ligament over the extensor tendons, separating them from the superficial veins and nerves. Beneath this are special fibrous membranes over the interossei muscles.

Palmar fascia. The *palmar fascia* consists of a central and two lateral portions.

Lateral part. The lateral pieces are very thin; they afford a delicate covering to the muscles composing respectively the thenar and hypothenar eminences.

Central part; The central portion is one of the strongest fasciæ of the body. Occupying the interval between the eminences just named, and expanding towards the fingers, it has a somewhat triangular or fan-like form. The narrow end of the fascia, thicker than any other part and composed of close parallel fibres, is connected with the anterior annular ligament, and receives the tendon of the palmaris longus muscle; the broader portion, becoming thinner and flatter as it advances towards the fingers, has a much more irregular and interlaced texture, and adheres more closely to the skin of the palm. Near the front of the palm it divides into four processes, each of which, corresponding to a finger, soon splits again to arch over the sheath of the flexor tendons; and the bundles of fibres thus separated, and dipping on each side of the tendons, are attached to the margins of the metacarpal bone and to the transverse ligament which binds the metacarpal bones to each other.

Ends in four processes which are connected with bones and a ligament.

From the centre of each process longitudinal fibres are continued to the skin as far forwards as the root of the fingers. These divisions of the palmar fascia are held together by irregular transverse fibres, which lie immediately under the skin, adhering to it and on this account rendering the band indistinct, and serve to give great additional strength at the points of divergence. (See also p. 217.) Interposed between the digital processes now described are the digital arteries and nerves.

and with the skin.

The palmar fascia on its cutaneous surface gives origin to some of the fibres of the palmaris brevis. It covers immediately the palmar arteries and nerves with the tendons of the flexor muscles.

FASCLÆ OF THE ABDOMEN.

As the fasciæ are merely accessory to other structures, especially the muscles, they vary in different situations with the purposes to which they are subservient. In the limbs the muscles are arranged in elongated masses; and, being frequently unattached to bone except at their opposite ends, they have a considerable tendency to displacement during the varied and extended motions of the limbs: so that the investing fasciæ are for obvious reasons strong and distinct. But over the abdomen the muscles, having a regular stratiform arrangement, are held firmly not only at the ends but at the margins, and they are not liable to such alteration in position as results from the extensive movements of the joints in the limbs. Under such circumstances an investing fascia is little required, and it is in fact proportionally little developed. One muscle (the rectus) which, differently from the rest, is long, narrow, and fixed only at the ends, is retained in its position by a peculiar arrangement of aponeurotic structure (page 121).

The fasciæ of the abdomen contrasted with those of limbs.

On the abdomen there are recognised—*a.* the superficial fascia, as in other situations; *b.* a special layer of fascia on the inner surface of the deepest muscle, and immediately lining the cavity, which is named from the muscle with which it is in contact; *c.* a delicate layer of membrane immediately investing the muscular fibres, and the representative of the well-developed deep fascia which encases the muscles of the limbs and the neck.—The structure last referred to needs only to be indicated; the other fasciæ require detailed examination.

Fasciæ which are recognised.

Two layers in inguinal region.

External or Superficial fascia.—Over the greater part of the abdomen this fascia presents the appearance of a single membrane ; but in the inguinal region it consist obviously of two layers, which differ so materially from each other in appearance, structure, and connections, as to require distinct mention.

Subcutaneous layer.

The *subcutaneous layer* consists, like the superficial fascia of the neck and thigh, of strata of connective tissue containing fat in greater or less quantity, with superficial bloodvessels and lymphatics. In fat bodies this structure may be partly separated by dissection into several irregular layers. In lean bodies it has more of a membranous character, but is still split at certain points as it were to embrace and contain the superficial vessels. Traced towards the linea alba, the penis, and scrotum, this superficial portion is found to contain less and less fat, until finally it ceases to exist as a distinct structure, becoming by degrees inseparably united to the deeper layer. Over Poupart's ligament it is continuous with the superficial fascia of the thigh ; and more externally, with that covering the gluteal region.

Deeper layer.

The *deeper layer* of the superficial fascia (aponeurosis of Scarpa) is thinner than that just described, and more distinctly membranous in its appearance and structure. Between this layer and the subcutaneous one already noticed, are placed near Poupart's ligament the superficial inguinal bloodvessels and the lymphatic glands. This deep layer, traced downwards over the external oblique muscle, is

Connected with fascia lata.

connected with Poupart's ligament by fine tissue, and ends in the fascia lata across the thigh a little below that ligament. Over the spermatic cord, the superficial fascia (its two layers being here blended one with another, and devoid

Continued in scrotum.

of fat) descends to the scrotum, and becomes continuous with the corresponding structure in the perinæum. Lastly, nearer the middle line, it is continuous with the membranous sheath of the penis.

In parts muscular.

In the scrotum and on the penis involuntary muscular fibre is developed in the superficial fascia, and the fatty tissue is absent from its meshes. To this altered structure the term *dartoid* tissue is applied.

Lining membrane of abdomen.

Lining membrane of the abdomen.—On the inner surface of the wall of the abdomen is a membranous structure which lines the visceral aspect of the deepest stratum of the muscles. This membrane or fascia is continuous all over the front of the cavity, which it assists in closing, and

it has been named from the muscle with which it is in contact.

Fascia transversalis (A. Cooper).—The membranous lining of the abdomen, namely, that corresponding with the anterior and lateral parietes, has been described under this name, on account of its close connection with the inner surface of the transversalis muscle. As in the case of other abdominal fasciæ, it is strongest and most clearly demonstrable in the inguinal region, where the muscles are somewhat defective; and here also it is of particular interest, on account of its forming a covering for inguinal hernia. Followed upwards from this situation the transversalis fascia becomes gradually thinner, and beyond the margin of the ribs it degenerates into a thin covering for the under-surface of the diaphragm. Traced on either side also, it becomes thinner as it approaches the loins, where, from the thickness and comparative immobility of the abdominal walls, it may be said to be less required to support the viscera. The transversalis fascia is continuous below with the iliac fascia—a smaller portion of the lining membrane of the abdominal walls, by means of a prolongation sent over the large vessels as these pass from the abdomen to the lower limb.

Fascia transversalis; thick below.

Connection with fascia iliaca.

Along the inner surface of the iliac crest, between the iliacus and transversalis muscles, the fascia is attached to the periosteum. For about two inches from the anterior superior iliac spine inwards, it is closely connected with the posterior surface of Poupart's ligament, and is there directly continuous with the fascia iliaca, which comes forward from the iliac fossa,—a white line sometimes marking the place at which the one is continued into the other. At this point also, and to the same extent, the fascia lata of the thigh is closely united with Poupart's ligament, which is here very strong, and serves as a point of union of several layers of fascia. About midway between the iliac spine and the pubes, the large artery and vein (which lie in front of the iliac fascia) prevent, as they pass out into the thigh, the fascia transversalis from joining the fascia iliaca, and from this point to the edge of Gimbernat's ligament the fascia transversalis is prolonged downwards over the artery and vein, forming the anterior portion of the femoral sheath. This part or prolongation of the fascia transversalis is not very closely connected with Poupart's ligament, under which it passes. It is here strengthened by a dense band of fibres,

Arrangement at Poupart's ligament.

Forms part of femoral sheath.

which arches over the vessels, and is inserted into the pubic crest and pectineal line, behind the conjoined tendon of the transversalis and internal oblique, and the reflected insertion of the external oblique aponeurosis. This band is sometimes called the *deep crural arch*.

Deep crural arch.

Lastly, about half way between the anterior superior iliac spine and the symphysis pubis, and about half an inch above Poupart's ligament, the spermatic cord in the male, and the round ligament in the female, pierce the fascia transversalis; and these structures, instead of passing through a mere foramen in the membrane, receive respectively from the fascia a delicate funnel-shaped covering, which is prolonged upon them. The opening thus formed in the transversalis fascia is called the *internal abdominal ring;* but the scalpel must be used to cut the delicate sheath around the cord, before anything like a ring or defined aperture can be seen.

Internal abdominal ring.

Fascia iliaca.

The *fascia iliaca*, more limited in extent, but stronger than the fascia transversalis, lines the back part of the abdominal cavity, and covers not only the muscle from which it derives its name, but also the psoas. The densest portion of its fibres is stretched transversely from the iliac crest, over the margin of the psoas muscle to the brim of the pelvis, where it is intimately blended with the periosteum. Upwards, this membrane, becoming much weaker, is connected internally with the sacrum, and by small and distinct processes with the intervertebral substances and the neighbouring margins of the lumbar vertebræ; and finally it becomes blended with the fascia lumborum at the ligamentum arcuatum externum. The external iliac vessels lie on or in front of this part of the iliac fascia.

Iliac vessels before fascia.

Arrangement at Poupart's ligament.

Along the line corresponding to the division between the abdomen and the thigh, the iliac fascia is thus disposed. To the outer side of the external iliac artery, it turns forwards to be connected with Poupart's ligament and the fascia transversalis, as already described; to the inner side of the femoral vein it is attached to the ilio-pectineal line, where also the fascia lata, being traced upwards, is found to terminate; and between these two points, namely, behind the femoral vessels, it continues downwards over the margin of the pelvis, forming the back part of the sheath of those vessels.

Femoral sheath.

Regarding the femoral sheath, it may here be stated,

that though its fore part is said to be continued from the fascia transversalis, and its hinder part from the fascia iliaca, the sheath is formed of continuous membrane:—the mode of describing it, which appears to imply a separation, resulting necessarily from the division of the internal abdominal fascia into two parts. Considering the transversalis and iliac fasciæ as but parts of the same membrane below, but differently named above from their position on different muscles, the femoral sheath would correspond in its construction with the funnel-shaped covering given to the spermatic cord. Its connection with fascia transversalis and fascia iliaca.

The psoas parvus is closely connected with the iliac fascia, by means of fibres sent off from its tendon.

The *lumbar fascia* (fascia lumborum) has been already described with the abdominal muscles (p. 124); with which, indeed, it is anatomically more closely related than it is with the fasciæ properly so called. Lumbar fascia.

FASCIÆ OF THE PERINÆUM.

The fasciæ of the perinæum correspond in a great measure with those at the lower part of the abdomen. They consist of the superficial fascia, which is beneath the skin, and of a deeper fascia, which may be considered the boundary of the pelvic cavity.

Superficial fascia of the Perinæum.—The two laminæ of which this is composed, as in the corresponding fascia of the groin, differ so materially from each other that they must be separately described. The outer or *subcutaneous layer* is thick and contains a quantity of fat, is more adherent to the skin than to the subjacent layer, and is prolonged continuously over the buttocks and thighs, without any attachment to the periosteum. Traced forwards, however, it is gradually lost sight of in the scrotum, where, losing its fat, it joins inseparably with the deeper layer, and becomes muscular or dartoid in texture. Superficial perinæal fascia, two layers.

The *deeper layer* of superficial fascia is thinner but more distinctly membranous, and contains little or no fat; it invests closely the perinæal region, without extending laterally over the thighs, and has the following important connections with other structures. Thus, on each side, this deep stratum is closely connected with the subpubic arch as far as the ischial tuberosity, so much so, that air injected under it cannot be made to pass in that direction. In front Deep layer, connected with bone at each side,

continued into scrotum; it is continued into the scrotum, and thus becomes continuous with the deeper layer of the superficial fascia of the abdomen. Behind it turns round the posterior margin of the transversus perinæi muscle to join with the deep perinæal fascia, to be presently described. (connection with deep fascia.) The attachment of this stratum of the superficial fascia laterally and behind, and its continuity with the scrotum in front, account for the course taken (as long as this fascia remains entire) by urine extravasated from rupture of the urethra. From the under surface along the middle line is an incomplete septum, corresponding with that of the scrotum, projected towards the urethra.

Deep perinæal fascia; The *deep perinæal fascia* (triangular ligament,—Douglas; triangular ligament of the urethra,—Camper) lies under the proper perinæal muscles, closing in the anterior portion of the outlet of the pelvis. It is a very strong and resistant membrane about one inch and a half in depth. Necessarily (triangular;) triangular in form in consequence of the direction of the bones with which it is connected, the apex of this fascia corresponds with the arch of the pubes and is fixed into (attached to bones.) the bone; the two sides are firmly attached to part of the subpubic arch, behind the insertion of the crura penis; and the base turned towards the rectum has connections to be presently described. It is pierced by the membranous portion of the urethra, about an inch below the pubes; and above or in front of this, by the dorsal veins of the penis.

Consists of two layers. The deep perinæal fascia is composed of two layers, between which are contained the pudic vessels and nerves with the arteries of the bulb, Cowper's glands, and the tube of the urethra with the compressor muscle. These two layers are differently disposed at the urethral aperture and (Urethral aperture.) at the base or free margin of the fascia. Thus, at the front of the margin of the urethral aperture it is continuous with the corpus spongiosum urethræ; and at the back with the fibrous investment of the prostate gland,—so as to leave the opening imperfectly defined on both the outer and the inner aspect.

Arrangement at base of fascia. Towards its base the fascia becomes weaker, and joins with the deep layer of the superficial fascia already described as turning in to meet it: and with it is connected a thin membrane which is spread over the outer surface of the levator ani.

FASCIÆ OF THE PELVIS.

Compared with fasciæ of abdomen. The pelvis is lined with fascia in the same manner as the abdomen. But in this cavity is a portion which is directed inwards from the parietal stratum to the viscera, and serves as a visceral layer: so that the fascia in the pelvis consists of two parts—one lining the cavity, the other assisting to support the viscera.

A parietal and a visceral layer.

Names. The chief membrane descends from the brim and upper part of the pelvis, and lining the cavity, is named "pelvic fascia;" but it sometimes has the name "obturator fascia" (from the muscle it is chiefly in contact with) applied to it below the point at which the visceral piece ("vesical" or "recto-vesical") is given off. It might in this way be said that the pelvic fascia, after descending a certain distance, splits into the obturator and recto-vesical fasciæ.

The deep perinæal fascia already described (p. 208) has likewise a claim to be referred to among the fasciæ of the pelvis, inasmuch as it closes the cavity beneath the pubic arch.

The membranes, or layers of membrane, whose arrangement has been thus noticed generally, will be now separately examined.

Pelvic fascia lines pelvis. The *pelvic fascia* lines the parietes of the cavity of the pelvis, furnishing attachment to the obturator muscle. At the side of the cavity this fascia is attached for a short space to the brim of the pelvis; but farther forwards, its attachment to the bone or periosteum inclines downwards behind the pubes, following the margin of the obturator internus towards the lower part of the symphysis.

Attachments, above and below. Descending in the cavity, the fascia is fixed below to the margin of the sacro-sciatic ligament, and to the sub-pubic arch; and below the pubes it blends with the posterior layer of the triangular ligament of the urethra. At the back part of the pelvis a thin membrane is continued from it over the pyriform muscle and the sacral nerves, and is perforated by branches of the internal iliac artery and vein. In front, the fascia is connected with the fibrous part of the canal by which the obturator vessels and nerve escape from the pelvis.

Level of a thick band. At the level of a line from the symphysis pubis to the ischial spine is a white thickened band. From the under surface of this band the levator ani muscle arises, and in the same place springs the layer of fascia which follows the upper surface of that muscle to the viscera—the vesical fascia.

Obturator fascia only part of pelvic;

Obturator fascia.—This is but the continuation of the pelvic fascia over the lower part of the internal obturator muscle, below the white band above mentioned, and being so,—to recognise it under a separate designation seems superfluous. The internal pudic vessels and nerve in their progress upwards to the perinæum, are contained in a canal formed in this—the lower portion of the pelvic fascia.

encloses pudic vessels.

Vesical fascia;

origin;

The *vesical fascia* (recto-vesical), the visceral layer of the pelvic fascia, takes its rise from the band (ischio-pubic) before mentioned as stretching from the pubes to the ischial spine, and descends, immediately in contact with the inner surface of the levator ani muscle, to the prostate gland, the urinary bladder, and the rectum. It is reflected to some extent on each of those organs from the point at which it comes into contact with them. Close to the symphysis pubis, a short band is directed backwards above the prostate gland, to the bladder, with which it is intimately connected. A similar band exists at the opposite side of the symphysis pubis, and the two are separated by a narrow depression, in or opposite which, the dorsal veins of the penis lie, after entering the pelvis. The bands in question are named the *anterior true ligaments of the urinary bladder.* At the side of the bladder and prostate, it gives an elongation forwards on the veins (prostatic) which cover the prostate. Where it is reflected inwards to the side of the bladder, it forms the *lateral true vesical ligament.* It invests the vesiculæ seminales, and is extended across between the bladder and the rectum; continuing into the membrane of the opposite side, it supports the bladder, and separates that organ from the intestine. On the rectum the fascia is also reflected upwards and downwards, gradually degenerating into a thin membrane over the surface of the bowel, as it likewise does on the bladder.

follows levator ani.

Anterior true ligaments of the bladder;

gives sheath to the prostate;

forms lateral true ligament of bladder.

Invests the rectum.

In the female the pelvic fascia is connected with the vagina in the same way as with the other pelvic organs.

FASCIÆ OF THE LOWER LIMB.

In the lower limb as in other situations, the fasciæ consist of two very distinct structures;—the one subcutaneous, and composed of connective tissue more or less loaded with fat; and the other forming an immediate and strong fibrous investment to the muscles of the limb.

The *superficial fascia* is more distinctly membranous in the upper part of the thigh, than in the other parts of the limb; but in the sole of the foot it is so slight, the skin and the deep fascia being closely connected together, that the superficial fascia can be scarcely said to exist. In the groin it is described more minutely than elsewhere on account of its connections with the deep fascia (fascia lata), and the influence which it consequently exercises over effusions of fluid in this neighbourhood. Besides the subcutaneous fat, the superficial vessels and glands are contained in this membrane; and as these are large and numerous, and are covered on both surfaces, it follows that the superficial fascia is here capable of partial subdivision into two or more imperfect laminæ. The outermost of these is continuous uninterruptedly with the subcutaneous layer of the abdomen above, and with the corresponding structure in the thigh below: but the innermost layer is continued as before said (p. 204) into the fascia lata a little below the level of Poupart's ligament. This union with the deep fascia is so complete, that air or liquid injected under the superficial fascia of the abdomen cannot be made to pass without direct rupture into the thigh, or *vice versâ*. At the top of the thigh it is stretched over an opening for the saphenous vein, adhering to the margin of that aperture, and assists in closing it. As the portion of the layer covering the saphenous opening is perforated by several superficial vessels, it has received the distinctive appellation of the *cribriform fascia*. About two inches below Poupart's ligament the superficial fascia is found wholly distinct from, and scarcely attached to the fascia lata.

Superficial fascia of thigh; contains superficial vessels and glands. Connection with fascia lata. Cribriform fascia.

Synovial bursæ are found in the superficial fascia of the lower limb over the patella, the point of the heel, and the phalangal articulations of the toes.

Synovial bursæ.

DEEP FASCIA.

Beneath the skin and superficial fascia is found the proper investing fascia of the limb, which is named in the thigh, fascia lata, but in the leg and foot is designated from the part covered.

The *fascia of the thigh* (fascia lata) forms a perfectly continuous sheath to the thigh, varying much however in thickness in different parts. It is strongest on the outer aspect of the limb, where its dense and glistening parallel

Fascia lata its unequal density.

fibres give it much the appearance of a tendinous aponeurosis ; indeed, it here serves the purpose of a tendon to the tensor vaginæ femoris, and to a large part of the gluteus maximus, both which muscles act on the limb through the intervention of the fascia. This membrane is thinnest in the upper and inner part of the thigh, where it covers the short adductor muscles. Near the knee, it is considerably strengthened by tendinous expansions given off from the lower termination of the extensor and flexor muscles of the knee-joint.

Connections with the periosteum.

Direct union between the fascia lata and the periosteum occurs at various points, more especially above at the side of the sacrum and coccyx, along the iliac crest and the pectineal line, and at the pubic arch ; and below over the condyles of the femur, the tuberosities of the tibia, and the head of the fibula. Indirectly, the fascia is still farther connected with the periosteum by means of septa which pass between the muscles to the shaft of the femur. These will be hereafter more particularly described.

The sheath-like arrangement of the fascia round the entire limb is simple over the greater part of the thigh ; but a little below Poupart's ligament an interruption to this continuity exists in consequence of the presence of an

Saphenous opening;

oval and somewhat oblique opening—*saphenous opening*, for the transmission of the principal superficial veins. Femoral hernia descends too through this same channel ; and it is with the view of permitting a more precise description of this opening that the two portions of the fascia lata, which lie respectively on the outer and inner side, are separately named,—that at the outer side attached to the iliac part of the hip-bone being called the iliac portion ; and that on the inner side, connected with the pubes, being named the pubic portion.

Up to the lower margin of the saphenous opening the membrane is single ; but at that point the two portions above named separate to enclose the saphenous opening.

its inferior cornu.

The lower curved margin of this aperture is called its *inferior cornu*.

Iliac portion of fascia lata;

The *external* or *iliac* portion, traced upwards from this point, lies on, and is intimately united with the anterior portion of the subjacent sheath of the femoral vessels. Crossing to the inner side of this sheath it forms an arched margin—*upper cornu* of the saphenous opening, which looks downwards and inwards ; this margin is less perfectly de-

fined than the inferior cornu, partly from its union with the cribriform fascia, and partly from its adhesion to the femoral sheath beneath, in the manner already indicated. Approaching yet nearer the fold of the groin the iliac portion of the fascia lata expands transversely, and corresponds with nearly the entire width of the thigh. At the crest and anterior superior iliac spine it is attached through the medium of the periosteum to the bone; and from this point inwards it is intimately joined to Poupart's ligament. At its inner termination, beneath the attachment of the external pillar of the abdominal ring to the pubic spine, it is attached to the pectineal line in union with the reflected insertion of the aponeurosis of the external oblique muscle.

its upper attachments.

The *inner* or *pubic* portion of the fascia lata, also followed from the inferior cornu, rises over the pectineus muscle, and passing deeply behind the femoral sheath, lies on a plane posterior to the iliac portion just described. On the outer side it becomes closely applied to the femoral sheath (its posterior surface), and may be traced even to the sheath of the psoas muscle and to the fibrous capsule of the hip-joint. On the inner side it is connected with the margin of the pubic arch. Above, it is attached to the pectineal line, close in front of the insertion of the external oblique aponeurosis. The cribriform fascia is less firmly connected with the pubic than with the iliac portion of the fascia lata.

Pubic portion of fascia lata; its upper attachment.

This investing fascia sends partitions as in other parts between the several muscles of the limb; these partitions are indicated on the surface by dense white lines. The strongest and deepest of the partitions is called the *external intermuscular septum*. It is situate between the vastus externus and the short head of the biceps, is inserted into the linea aspera of the femur from the lower edge of the tendon of the gluteus maximus to the outer condyle of the bone, and serves to attach the muscles to the bone, and retain them in their situations during their different actions, by fixing the strong external portion of the fascia lata. The *internal intermuscular septum* is a much thinner stratum; it is inserted into the femur between the vastus internus and the adductor muscles.

Inter-muscular septa; external and internal;

Several muscles are inserted into the fascia lata, and act more or less as tensors of that membrane. The tensor vaginæ femoris (see page 146) indeed has no other inser-

connection of muscles with fascia.

tion, and is the proper tensor muscle of the fascia; its fibres are enclosed between two layers of the membrane, which unite together at the distance of three or four inches below the pelvis. The gluteus maximus, which is somewhat similarly enclosed between two layers, is also partly inserted into the fascia over the great trochanter of the femur. In the same manner, though to a smaller extent, the tendon of the biceps behind; and those of the sartorius, gracilis, semi-tendinosus, and extensor cruris in front, send bundles of fibres to strengthen and support the fascia round the upper part of the knee-joint. Other muscles, again, take a partial origin from it or its prolongations inwards. Thus, many of the fibres of the gluteus medius arise from the dense portion of fascia stretching between the tensor vaginæ femoris and the gluteus maximus. From the external intermuscular septum, arise many muscular fibres of the vastus externus and of the short head of the biceps. Lastly it may be mentioned, that the fascia lata forms a very distinct sheath for the sartorius by splitting at the outer and re-uniting at the inner margin of that muscle, as the cervical fascia does for the sterno-mastoideus.

Insertion into it.

Origin from it.

Fascia of leg;

The *fascia of the leg* is continuous around the knee with the fascia lata of the thigh, and over the ankle with the corresponding investment of the foot. It is particularly dense in the upper and fore part of the leg; and it is strengthened by fibres sent from the tendons of the biceps on the outer, and the sartorius, gracilis, and semi-tendinosus on the inner side, but it becomes much thinner behind, where it covers the gastrocnemius and soleus muscles. This fascia is adherent to the periosteum covering the head, the spine, and the posterior margin of the tibia; to the head of the fibula, and to the outer and inner malleoli; and it invests the leg all round except the inner surface of the tibia. From its under surface intermuscular septa are prolonged inwards. The situation of these septa is marked on the surface of the fascia by several white lines in front and on the outer side of the leg. The first, on the outer side of the spine of the tibia, runs between the tibialis anticus and the extensor longus digitorum, and is attached deeply to the inter-osseous ligament; and the second, extending between the long extensor and peroneus tertius in front, and the peroneus longus and brevis behind, is inserted along the anterior margin of the shaft of the fibula. These septa, as well as the upper and anterior portion of the fascia itself,

attachments.

Inter-muscular septa;

use.

afford attachment to the muscular fibres next to them, and thus increase greatly the extent of the surfaces giving origin to the muscles.

Between the superficial and the deep muscles on the back of the leg, a layer of fascia is stretched from side to side across the limb. This membranous septum, known as the *deep fascia of the leg*, extends over the popliteus muscle: on this muscle it is strong, and is joined by an offset from the semi-membranosus muscle. Where covered by the soleus and gastrocnemius, the fascia is weak, but it becomes stronger as it escapes from under cover of those muscles and approaches the malleoli. **Deep fascia of leg.**

Around the ankle the fascia of the leg becomes continuous with that of the foot; but in front, and on the sides of that joint, strong bands of fibres are superadded, which are called annular ligaments. As they are merely stronger portions of the ordinary fascia, it is often difficult in dissection to mark satisfactorily the outline of the upper and lower margins of these bands. Their function is that of confining the tendons in their natural positions. **How arranged at ankle.**

The *anterior annular ligament* is partly separated near the flexure of the joint into two portions or bands, the one properly belonging to the leg, and the other to the foot. **Anterior annular ligament;** The *upper band* stretches from the lower end of the fibula to the lower end of the tibia, and binds down the vertical portion of the extensor tendons to the point at which they make their turn forwards to the foot: in it is one separate sheath for the tendon of the tibialis anticus. **upper and** The *lower band* is attached internally to the lower part of the malleolus and the plantar fascia, and externally to the upper surface of the os calcis in front of the interosseous ligament of that bone; it confines the horizontal portion of the same tendons to the dorsal surface of the tarsal bones. **lower band;** By splitting into two layers, and passing partly in front and partly behind the tendons, these bands form several sheaths, which are lined by synovial membranes. The compartment of the annular ligament next the fibula is appropriated to the peroneus tertius and extensor communis digitorum; a second, next the tibia, contains the tendon of the tibialis anticus; and a third transmits the extensor proprius pollicis. The band covers the anterior tibial vessels and nerve. **forms sheaths for tendons.**

The *internal annular ligament* crosses the space between the inner ankle and the heel, through which the tendons of the flexor muscles run. Its upper border, continuous with **Internal annular ligament;**

the fascia of the leg (more especially the deep layer), is very imperfectly defined ; and its lower border, giving origin to many fibres of the abductor pollicis, is but little more distinct. Its anterior extremity is attached to the inner malleolus, and its posterior termination is inserted into the inner margin of the calcaneum ; but between these two points it encloses with grooves in the bone several arched

sheaths for tendons.

canals for the tendons. The first canal (next the malleolus) contains the tendon of the tibialis posticus, and the second that of the flexor longus digitorum, each being provided with a synovial lining. Then follows a wider space for the passage of the posterior tibial vessels and nerve. Lastly, a fourth canal against the astragalus, lined like the two first by a synovial bursa, transmits the tendon of the flexor longus pollicis.

External annular ligament.

The *external annular ligament* extends from the point of the outer malleolus to the outer surface of the calcaneum, and keeps in place the tendons of the long and short peronei muscles. The tendons are close together, and they are surrounded by one synovial sac.

Dorsal fascia of foot:

The *fascia on the dorsum of the foot* is a thin membrane prolonged from the anterior annular ligament over the

superficial,

extensor tendons. It is attached, more or less closely, to the inner and outer borders of the foot, and is continuous round the margins with thinner and degenerated portions of

and deep.

the plantar fascia. Special deep fasciæ over the short extensor of the toes and the interosseous muscles are situate beneath the former layer. All are blended in front over the interosseous spaces.

Plantar fascia;

The *plantar fascia* is much stronger and thicker than any other of the fibrous membranes. It is composed of dense, white, glistening fibres, the greater number of which are arranged in a longitudinal direction, and extend from the under surface of the os calcis forwards to the heads of the

three parts;

metatarsal bones. This fascia may be described as composed of three pieces, (a central and two lateral,) of very different degrees of thickness, and clearly marked off from each other

inner piece;

by two strong intermuscular septa. The *inner* portion, very thin and unlike the others, invests the abductor pollicis, and is often partly removed with the skin in dissection. It is continuous round the inner border of the foot with the dorsal fascia and with the internal annular liga-

outer part.

ment. The *outer* part covers the abductor minimi digiti, and is much stronger, particularly between the under surface

of the calcaneum and the base of the fifth metatarsal bone, to both which points it is firmly attached. It is continuous round the outer border of the foot with the dorsal fascia, and sends a thin prolongation forwards over the insertion of the abductor and the short flexor of the little toe. The *central portion*, like the corresponding part in the palmar fascia, is narrow behind, and becomes wider and thinner towards the toes. At the back, where it is thickest, the fascia is attached to the inner tubercle on the under surface of the calcaneum immediately behind the origin of the flexor brevis digitorum, with which muscle it is closely connected. Nearly opposite the middle of the metatarsal bones this fascia, becoming broader and thinner as it advances, begins to divide into five processes, one for each of the toes; and from this point forwards to the base of the toes, numerous strong transverse fibres are superadded, which bind the processes together, and connect them closely with the skin. Near the articulation of the toe with the metatarsal bone, each of the five processes divides, to permit the passage of the flexor tendons; and the two bundles of fibres resulting from the division of each process, after strengthening the sheath of the tendons over which they pass, are attached to the sides of the metatarsal bone, and are blended with the transverse ligament uniting those bones. From the point of splitting of each process, as in the hand, fibrous bands are continued forwards to the skin as far as the web of the toes.

Central portion is narrow behind, broad in front;

divides into five processes,

and these subdivide;

their ending.

It has been already intimated that the three parts of the plantar fascia are united together along the whole length of the foot, so as to form a continuous membrane. Their union is marked on the surface by two longitudinal depressions or grooves. Opposite these grooves two strong *intermuscular septa* are prolonged deeply upwards into the sole of the foot; these separate the flexor brevis digitorum from the abductor pollicis on the inner side, and from the abductor minimi digiti on the outer side, and give partial origin to each of these muscles. Finally, the intermuscular septa are connected with thin membranous partitions, which are interposed between the respective layers of muscle in the sole of the foot.

Inter-muscular septa.

In both the foot and the hand there is a band of transverse fibres across the roots of the digits. It is placed immediately beneath the skin, and is connected with the subjacent sheaths of the tendons. Underneath it pass the digital nerves and vessels. The name *transverse ligament* of the toes or fingers, according to the limb, has been applied to it.

Transverse ligament of digits.

ARTERIES.

In describing the arteries in the following pages, reference is frequently made to a special work on the subject.* Such references are placed, without repeating the title of the work, within square brackets [ ]. They will thus be readily distinguished from the numbers and letters of the woodcuts, which are not within brackets.

Vascular system consists of arteries and veins. Arteries are pulmonary and systemic.

An outline of the vascular system has been already given, in which the distinctive characters of the two great sets of bloodvessels, the arteries and the veins, have been pointed out. The subdivision of the arterial system into *pulmonary* and *systemic* arteries has been also described :—the former conveying blood from the right side of the heart into the lungs, and the latter carrying that fluid from the left side of the heart to all parts of the body. The pulmonary artery and its divisions will be noticed with the lung to which it is distributed. In this place we enter upon the consideration of the systemic arteries: these commence by means of a large single vessel, named the aorta, from which as from a large trunk branches are distributed to all parts of the body.

THE AORTA.

Aorta; is partly in thorax, partly in abdomen. Extent; ends at fourth lumbar vertebra.

The aorta or great artery, fig. 138, A B C [Pl. 48,] (ἀορτὴ; arteria magna),† is the large main trunk of a series of vessels which convey red or oxygenated blood from the heart over the entire body. It is situate in front of the vertebral column, partly within the thorax and partly in the abdomen. It commences at the left ventricle of the heart, and after arching over the root of the left lung, descends within the thorax along the vertebral column; it then passes through the diaphragm into the abdominal cavity, and ends opposite the fourth lumbar vertebra, by dividing into the right and left common iliac arteries. In this course the

* "The Anatomy of the Arteries of the Human Body, with its application to Pathology and Operative Surgery," in lithographic drawings and commentaries. By R. Quain. London, 1844.

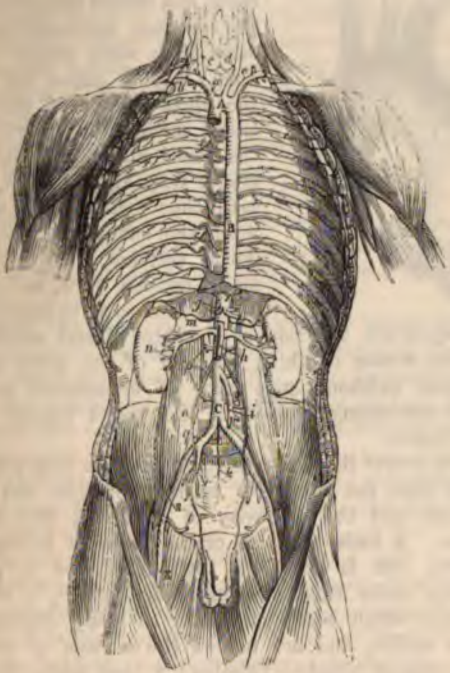
† The terms ἀορτὴ ἀρτηρία, are apparently compounded of the words ἀὴρ, *air*, *spirit*, and τηρεῖν, *to keep* or *guard*; the ancients believing that the arteries contained vital air, or spirits, during life.

primary systemic artery forms a continuous undivided trunk, which gradually diminishes in size from its commencement to its termination, and gives off larger or smaller branches at various points. Different parts of the vessel have received particular names, derived from their position or direction:—the following are recognized, viz. the *arch of the aorta*, the *thoracic aorta*, and the *abdominal aorta*. The short curved part, fig. 138, A, which reaches from the

Sub-divisions.

The arch;

Fig. 138.



ventricle of the heart to the side of the third dorsal vertebra, is named the *arch*; the straight part, B, which extends from that vertebra to the diaphragm, is called the *thoracic* aorta; and the remainder of the vessel, C, down to its bifurcation, is spoken of as the *abdominal* aorta. These three parts will be examined separately, the first part or arch being

the thoracic and abdominal aorta.

described immediately, and the other portions in subsequent pages.

ARCH OF THE AORTA.

The arch of aorta; its commencement, course,

The arch of the aorta, fig. 139, [Pls. 1 and 2,] commences at the upper part or base of the left ventricle of the heart, behind the pulmonary artery. At first it passes upwards and to the right side, somewhat in the direction of the heart itself, and crosses obliquely behind the sternum, approaching at the same time more nearly to that bone; having gained the level of the upper border of the second costal cartilage of the right side, the vessel alters its course, and arches from right to left, at the same time inclining backwards to reach the left side of the second dorsal vertebra. At this spot it makes another turn, and changes its direction so as to incline downwards upon the left side of the third dorsal vertebra; at the lower border of which the arch of the aorta becomes continuous (without any mark of separation) with the straight descending portion of the vessel known as the thoracic aorta.

Fig. 139.*

and place of termination;

direction of its curve.

In this course it will be observed that the artery describes a curve with the convexity turned upwards and to the right side, and the concavity of course in the opposite direction. A little above its origin the aorta is larger than elsewhere, and is not quite cylindrical, for it presents externally three small bulgings, fig. 139, [1], [2], of about equal size, which correspond with as many dilatations or pouches within, and are named the *sinuses of the aorta* (arteriæ magnæ sinus,—Valsalva);† they might be termed

Three sinuses, connected with valves.

* The arch of the aorta as seen from before in its natural position. *a.* ascending part; *b.* transverse part; *c.* descending part; *d, e.* origin of the coronary arteries of the heart; *f.* innominate artery; *g.* left carotid; *h.* left subclavian. 1, 2, two of the three sinuses of the aorta; 3, the great sinus.

† Valsalvæ Opera. Venetiis, 1740. Dissert. Anatom. i., sect. ii., p. 129, tab. 21.

the sinuses of the aortic valves, in consequence of their connection with the functions of those valves. In this place it may be mentioned, that in most cases there exists along the right side of the first part of the arch a dilatation, named the *great sinus of the aorta* (arteriæ magnæ maximus sinus,—Valsalva), fig. 139,[3]. This partial dilatation of the vessel varies in size in different bodies, and occasionally is not to be detected.

Opposite the three sinuses at the root of the aorta, of which two are anterior and one posterior, the section of the artery has a somewhat triangular figure; but immediately below them, where it is attached to the base of the left ventricle, the vessel is smaller, and its border circular. This circular border is connected with the margin of the aortic orifice of the left ventricle of the heart by means of a dense fibrous structure of an annular form, which enters into three indentations presented by the border of the vessel between the three sinuses. The aorta is also connected with the heart by the serous layer of the pericardium, which is prolonged for some distance upon the vessel; and by the lining membrane of the left ventricle (endocardium), which is continuous with that of the whole arterial system.

Is triangular at sinuses,

circular below;

how attached to heart;

externally and internally a serous membrane.

Around the inner side of the orifice of the aorta, and corresponding in position with the three sinuses, three *semilunar valves* are attached. The free margins of these moveable membranes meet together so as to close the mouth of the vessel, and prevent the reflux of the blood from the aorta into the ventricle. Above two of the valves, and in the corresponding sinuses, are seen the orifices of the two coronary arteries of the heart, *d e*,—the first branches given off by the aorta.

Is closed by three valves.

From the difference in the direction and connections of different portions of the arch it is described as consisting of an *ascending*, a *transverse*, and a *descending* portion.

Arch subdivided into three parts;

The *ascending* portion, fig. 139, *a*, of the arch of the aorta is placed at its commencement behind the sternum, on a level with the lower border of the third costal cartilage of the left side; and it rises as high as the upper border of the second costal cartilage of the right side. Its length is about two inches or two inches and a quarter; and its direction is curved.

ascending part;

This portion of the aortic arch is enclosed in the pericardium, and, together with the pulmonary artery, is invested

is enclosed by the serous layer

of pericardium with pulmonary artery.

by a fold of the serous layer of that bag, in such a manner that both vessels are covered by the serous membrane, except where they are in contact with each other.

Connections.

At its commencement the ascending part of the arch is concealed by the pulmonary artery, and the right auricular appendage also overlaps it; but as, in ascending, the aorta passes to the right side and the pulmonary artery to the left, the former vessel comes into view. It approaches very near to the sternum, from which it is separated only by the pericardium, by some connective tissue, and by the remains of the thymus gland lodged in the mediastinal space. Higher up, the aorta has the descending vena cava on the right side, and the pulmonary artery (passing backwards) on the left: behind, it is supported on the right branches of the pulmonary vessels.

Transverse portion.

Parts in contact.

The second, or *transverse*, part of the arch, fig. 139, *b*, is directed from right to left, and from the sternum to the body of the second dorsal vertebra. At its left side it is covered by the left pleura and lung; and it is placed immediately in front of the trachea before its bifurcation into the bronchi. Here the aorta touches likewise the œsophagus by its posterior surface, and is placed over the thoracic duct. The upper border of this the transverse part of the arch has in contact with it the left innominate vein; and from it are given off the large arteries (innominate, left carotid, and left subclavian), which are furnished to the head and the upper limbs. The lower border is near the bifurcation of the pulmonary artery, and is connected with the left branch of that artery by the remains of the ductus arteriosus. At or near its end this part of the arch is crossed in front by the left vagus and phrenic nerves, with some offsets of the sympathetic; and the recurrent laryngeal branch of the vagus turns upwards beneath and behind it.

Connection with pulmonary artery.

Descending part of arch:

behind pleura.

The *descending* portion of the arch, fig. 139, *c*, which is straight in its direction, rests against the left side of the body of the third dorsal vertebra, and is covered by the left pleura. To the right side of this part of the arch is the œsophagus with the thoracic duct.

Parts contained within arch.

If the pulmonary artery be cut across at its root and drawn upwards, the curve formed by the arch of the aorta will be seen to enclose the pulmonary artery at its division, the root of the left lung, the left auricle of the heart, the left recurrent nerve, and the remains of the ductus arteri-

osus.—It may be observed at the same time that the aorta is connected with the pulmonary artery by the pericardium, and by the fibrous cord representing the ductus arteriosus of the fœtus.

Peculiarities of the arch.—It is proposed to notice briefly under the head of *peculiarities*, all the more frequent deviations from the usual arrangement of each arterial trunk and its branches, and especially such as may be interesting in a surgical or physiological point of view. For more extended information on this part of the subject, reference may be made to the work on the arteries before mentioned. In accordance with this plan, the peculiarities affecting the arch of the aorta will be now considered. Peculiarities.

The *height* to which the arch of the aorta rises in the chest is liable to some variation. Although its highest part is usually placed about an inch below the upper margin of the sternum, it may reach very nearly to the level of the top of the bone [plate 5, fig. 1]; and, on the contrary, it has been occasionally found an inch and a half below it, and (but this appears to be of very rare occurrence) as much as three inches from the same point [fig. 2]. In these cases, the length and position of the great branches which spring from the arch undergo corresponding modifications. Position of arch varies;

Change of direction.—The aorta sometimes presents the singular peculiarity of arching over the root of the right lung instead of that of the left, and afterwards continuing on the right side of the vertebral column [plate 5, fig. 3]. In these cases, the viscera are all transposed, and the vena azygos is removed from the right to the left side. In other instances again, which are less frequently met with, this change in the direction of the aorta is only temporary, for after arching over the right bronchus (with the vena azygos), it resumes within the thorax its usual position on the left of the vertebral column [plate 5]. curves to *right* side.

Peculiarities of Conformation.—The aorta has been observed to divide,* without forming any arch, into an ascending and a descending branch; the former of which was directed vertically for some distance, and then subdivided, like a cross, into three branches, to supply the head and upper limbs. ["The Arteries," &c., plate 5, figs. 6, 7.] This very rare disposition of the aorta corresponds with the usual arrangement in some quadrupeds; and since, at an early period in the history of anatomy, dissections were for the most part prosecuted on the bodies of the lower animals, the terms ascending and descending aorta came to be applied by the older anatomists to parts of the great systemic artery in the human body. Division into an ascending and descending trunk; as in some quadrupeds.

Another very unusual change of conformation is that in which the aorta divides soon after its commencement into two large branches, which unite again into a single trunk, corresponding to the descending Division and re-union.

* Klinz in "Abhandlungen der Iosephinischen Med. Chir. Acad. zu Wien." Band 1, S. 271, 1787; Troussieres in "Le Journal des Sçavans," Paris, 1729 [op. cit. plate 5, fig. 7, and p. 21].

portion of the aorta.* In one case of this kind (that recorded by Hommel), the trachea and œsophagus were found to pass through the vascular ring formed by the divided aorta; and they probably occupied the same position in the other cases also.

Peculiarities resemble arrangement in animals;

It is interesting to find that many of the peculiar conditions of the great systemic artery just mentioned, resemble the ordinary arrangements of that vessel in the lower vertebrate animals. Of this, one example in the case of quadrupeds has been already mentioned. The direction of the arch over the right instead of the left bronchus, is similar to the ordinary condition of the blood-vessel in birds. And the bifurcation of the ascending aorta, and the subsequent reunion of its two parts, resembles the arrangement of this vessel in the class of reptiles. It may farther be remarked, that the mode in which these peculiarities may be produced—by the persistence of certain conditions of the vessels in the human fœtus, or by slight changes effected during the progress of development—has in many cases been satisfactorily shown.

Mode of production.

THE BRANCHES OF THE ARCH OF THE AORTA TAKEN COLLECTIVELY.

Branches of aortic arch five in number.

The branches given off by the first part of the aorta are five in number. Two of these, named the *coronary* arteries, fig. 139, *d*, *e*, are comparatively small, and are distributed to the walls of the heart: they arise very near to the commencement of the aorta, and will be described hereafter (page 226).

Three large branches;

The other three branches from the arch are three large primitive trunks, which supply the head and neck, the upper limbs, and, in part, the thorax.

They usually arise from the middle or highest part of the arch, in the following order, fig. 139; first, the innominate or brachio-cephalic artery, which soon subdivides into the right subclavian and the right carotid arteries; secondly, the left carotid; and, thirdly, the left subclavian artery. The origin of the left carotid artery is ordinarily somewhat nearer to the innominate artery than it is to the subclavian artery of its own side.

their relative position.

* Hommel, in "Commercium Literarium." Hebdom. 21. Norimbergæ, 1737; Malacarne, "Delle osservazioni in chirurgia," &c., part II. 119; Zagorsky in "Mem. de l'Acad. Imp. des Sciences de St. Petersburg," t. 9.

These three vessels, with the branches and the peculiarities presented by each, will be described in succession; but it is necessary so far to anticipate as to notice in this place the variations which have been observed in their mode of origin from the aorta, as connected with the peculiarities of that vessel.

Peculiarities of the three branches.—Variations in the number and arrangement of the branches which arise from the aortic arch are of more frequent occurrence than those of the arch itself. They may be arranged into two classes: 1. Those in which the primary trunks, viz. the carotid and subclavian, or the innominate arteries, are concerned; and 2. Those in which one or more secondary branches, usually given from the subclavian, take origin directly from the aorta. ["The Arteries," &c., p. 43.] Peculiarities arranged in two classes.

1. *Peculiarities affecting the primary branches.*—These relate to the situation of the large branches upon the arch; to their contiguity to each other; or to an alteration in their number or arrangement. First class.

The situation of the branches.—Instead of springing from the highest part of the arch, the branches are frequently moved altogether to the right, and take origin from the commencement of the transverse portion, or even from the end of the ascending portion of the arch. In these cases the vessels arise lower down than usual, especially the innominate artery; and they are generally crowded together on the aorta [plate 6, figs. 1, 2]. Situation.

Their contiguity to each other.—In the ordinary arrangement the origin of the left carotid is nearer to the innominate than to the left subclavian; but the branches sometimes arise at equal distances from each other, or they are unusually apart. A very frequent change consists in the approximation (in various degrees in different cases) of the left carotid towards the innominate artery [plate 6, figs. 3 to 7]. Contiguity.

The number and arrangement of the branches.—These are extremely various. In a large series of observations the most frequent change met with in the number of the primary branches was their *reduction to two.* This most frequently arose from the left carotid being derived from the innominate artery [plate 6, fig. 7]. In other cases of rare occurrence, the carotid and subclavian arteries of the left side (as well as those of the right) took origin by an innominate artery [fig. 9]. Number. Primary branches reduced to two

On the other hand, the number of the primary branches has been found to be *augmented* to four, by the decomposition, as it were, of the innominate artery into the right carotid and subclavian arteries, which arose directly from the aorta [plate 6, figs. 10, and seq.]. increased to four;

In some of these cases, the right subclavian artery, as might be expected, was the first branch given off from the arch, the right carotid, the left carotid and the left subclavian following in regular order; but this vessel was likewise found to take origin beyond one or two of the remaining three branches, or, as in most instances, beyond them all—from the left end of the arch; and other variations, in the order in which the branches arise, have been noticed [op. cit. p. 48]. arrangement;

Again, examples have occurred of augmentation in the number of the five or six.

branches to five or six. In these cases the common carotid of one or both sides being absent, the external and internal carotid arteries arose from the aorta separately [plate 5, fig. 9; pl. 12, fig. 3].

Number of branches unchanged; order unusual.

In other forms of variety, the *number of the primary branches continues unchanged, but their arrangement is unusual.* Thus, when the aorta arches over to the right side, there may be three branches having the reverse of the ordinary arrangement, the innominate being on the left side [plate 7, fig. 3]. In other cases (the aorta having its usual course), the two carotids have been seen to arise by a common trunk, and the two subclavians separately—the right subclavian, in most instances, being transferred beyond the other branches to the left end of the arch [plate 7, figs. 4, 5].

A very unusual change, referrible to this form of peculiarity, observed by Tiedemann, consists in there being but one innominate artery, and that on the left side, although the aorta had its usual course over the left bronchus [plate 7, fig. 6].—This condition existed in an infant with hare-lip.

Second class.

Secondary branches added.

2. *Peculiarities in which one or more secondary branches, usually given from the subclavian, are derived directly from the aorta* [op. cit. plate 7].—In nearly all these, there is but a single secondary branch taking origin from the aorta; and such a branch, it may be remarked, has been found to accompany the ordinary arrangement of the primary branches [plate 7, fig. 7], or to co-exist with a diminution [fig. 10], or with an increase in their number [fig. 11]; that is to say, with all the conditions of the primary branches which have been just noticed.

The additional branch is almost invariably the left vertebral, which in nearly all such cases arises between the left carotid and left subclavian arteries; but it has been observed to proceed from the aorta beyond the last-named trunk [plate 7, fig. 8].

A thyroid artery has been seen, though but rarely, to arise from the arch of the aorta [plate 7, fig. 9].

Two secondary branches, taking origin from the aorta, have been very rarely met with. Those hitherto observed are the right internal mammary and the left vertebral; or, as in one singular case, both vertebral arteries [figs. 12, 13].

BRANCHES OF THE ARCH OF THE AORTA.

THE CORONARY ARTERIES.

Number and origin.

The coronary arteries are small vessels, two in number, which arise near the root or commencement of the aorta, immediately above the semilunar valves, fig. 139, *d, e.* They are called *coronary,* from the manner in which they encircle the heart near its base (*corona,* a wreath or garland). They have likewise been named *cardiac,* from their destination to the substance of that organ. The two arteries are distinguished as right and left coronary arteries from the direction they take, or from the sides of the heart which they respectively supply.

The *right coronary artery*, about the size of a crow's quill, is seen close to the right side of the pulmonary artery between it and the right auricle. It arises from the aorta just above the free margin of the right semilunar valve, and runs obliquely towards the right side of the heart, lodged in the groove which separates the auricle from the corresponding ventricle. Having passed the right border of the heart, the vessel continues its course in the same way along the posterior aspect of the organ, until it reaches the groove of separation between the two ventricles, where it divides into two branches. One of these continues transversely to the groove between the left auricle and ventricle, and anastomoses with the left coronary artery; whilst the other branch assuming a different course, runs longitudinally downwards along the posterior wall of the septum between the ventricles, giving branches to each ventricle and to the septum between them, and terminates at the apex of the heart by anastomosing with the descending branch of the left coronary artery on the fore part of the interventricular septum.

Right coronary; two branches; anastomose with left coronary.

In its course the right coronary artery gives, besides the offsets already noticed, small branches to the right auricle and ventricle, and also to the origin of the pulmonary artery. Along the right border of the ventricle a rather large branch usually descends towards the apex of the heart, and sends offsets in its progress to the anterior and posterior surfaces of the ventricle.

Offsets.

The *left coronary artery* is smaller than the preceding, and arises from the left side of the aorta higher up by a line or two. It passes behind and then to the left side of the pulmonary artery, appearing between that vessel and the left auricular appendage. At first it descends obliquely towards the sulcus which separates the ventricles of the heart in front, where it divides into two branches. Of these, one continues to pursue a transverse direction, turning outwards and to the left side in the groove between the left ventricle and auricle, and after reaching the posterior aspect of the heart, anastomoses with the transverse branch of the right coronary artery; the other branch, much the larger, descends on the anterior surface of the heart along the line of the interventricular septum towards the apex of the organ, and anastomoses with the long descending branch of the right coronary artery.

Left coronary artery; two branches; both anastomose with right artery.

The left coronary artery supplies some small branches at

Offsets. its commencement to the pulmonary artery, to the coats of the aorta itself, and to the left auricular appendage ; its two branches also furnish smaller offsets throughout their course, which supply the left auricle, both ventricles, and the interventricular septum.

Number diminished; *Peculiarities.*—The *coronary* arteries have been observed in a few instances to commence by a common trunk, from which they diverged and proceeded to their usual destination. The existence of three coronary arteries is not a very rare occurrence, the third being small, augmented. and arising close by one of the others. Meckel, in one instance, observed four, the supplementary vessels appearing like branches of one of the coronary arteries transferred to the aorta.

THE INNOMINATE ARTERY.

Innominate artery; The innominate artery (brachio-cephalic), fig. 134, *a* [plate 1 and 2], the largest of the vessels which proceed from origin, and extent; the arch of the aorta, arises from the commencement of the transverse portion of the arch before the left carotid. From this point the vessel ascends obliquely towards the right, until it arrives opposite the sterno-clavicular articulation of that side, nearly on a level with the upper margin of the clavicle, where it divides into the right subclavian, *b*, and the right carotid artery, *c*. Its place of bifurcation would, in most cases, be reached by a probe passed backwards through the cellular interval between the sternal and clavicular portions of the sterno-mastoid muscle. The length of ength. the innominate artery is very variable, but usually ranges from an inch and a half to two inches.

Connections in thorax; This artery lying within the thorax for the most part, is placed behind the first bone of the sternum, from which it is separated by the sterno-hyoid and sterno-thyroid muscles, and a little lower down by the left innominate vein, which crosses the artery at its root. The innominate artery lies in front of the trachea, which it crosses obliquely : on its left side is the left carotid artery, with the thymus gland or its remains ; and to the right is the corresponding innominate vein and the pleura.

usually no branch. In the ordinary condition no branches arise from this vessel.

Length; *Peculiarities.*—The length of the innominate artery now and then exceeds two inches, and occasionally it measures only one inch or less [plate 7, fig. 8, and plate 20, fig. 1]. Its place of division is a point of surgical interest, inasmuch as upon it in a great measure depends

the accessibility of the innominate itself in the neck, as well as the length of the right subclavian artery. Though usually bifurcating nearly on a level with the upper margin of the clavicle at the sternal end, it has been sometimes found to divide at a considerable distance above that bone [plate 20, fig. 3], and, but less frequently, below it [fig. 2]. place of division varies;

Lastly, though usually destitute of branches, this vessel has been observed to supply a thyroid branch [plate 23], and sometimes a thymic branch or one (bronchial) which descends in front of the trachea. gives a branch,

Sometimes there is no innominate artery, the right subclavian arising as a separate trunk from the aorta. The innominate artery has not unfrequently been seen to give origin to the left carotid [plate 6, fig. 7]. In cases of transposition of the aorta, an innominate artery, as might be expected, exists on the left instead of the right side [plate 5, fig. 3]. or is absent.

COMMON CAROTID ARTERIES.

The common or primitive carotid arteries of the right and left sides of the body are nearly similar in their course and position, whilst they are in the neck; but they differ materially in their place of origin, and consequently in their length, and position, at their commencement [plate 1]. On the right side the carotid artery commences at the root of the neck behind the sterno-clavicular articulation, at the place of bifurcation of the innominate artery; whilst on the left side the carotid arises within the thorax, from the highest part of the arch of the aorta, very near the origin of the innominate artery. The left carotid is therefore longer than the right, and it is at first placed deeply within the thorax. Difference in origin and length.

In consequence of this difference, it is convenient to describe, at first, the thoracic portion of the left carotid, or that part which intervenes between the arch of the aorta and the sterno-clavicular articulation, — after completing which the same description will suffice for both vessels. Thoracic part of left carotid.

Whilst *within the thorax, the left carotid* ascends obliquely behind, and at some little distance from the upper piece of the sternum and the muscles (sterno-hyoid and sterno-thyroid) connected with that part of the bone; it is covered by the remains of the thymus gland, and is crossed by the left innominate vein. This part of the artery lies in front of the trachea; and the œsophagus (which, at the root of the neck, deviates a little to the left side) and the thoracic duct are also behind it. The left carotid artery here lies between the innominate and the subclavian arteries, and the vagus nerve is to its outer side.

In the neck the common carotid artery, fig. 140, *a* [plate 16], of either side reaches from behind the sterno-clavicular Common carotids

alike in neck; extent; direction; articulation to the level of the upper border of the thyroid cartilage, where it divides into two great branches, of which one, *b*, is distributed to the cranium and face, and the other, *c*, to the brain and the eye. These divisions have, from their destination, been named respectively the external and internal carotid arteries.

course, how indicated; The oblique course taken by the common carotid artery along the side of the neck is indicated by a line drawn from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process of the temporal bone.

both diverge. At the root of the neck, the arteries of both sides are separated from each other only by a narrow interval, corresponding with the width of the trachea; but, as they ascend, the two vessels are separated by a much larger interval,—corresponding with the breadth of the pharynx and larynx. The appearance which the carotid arteries

Fig. 140.

have of being placed farther back at the upper than at the lower part of the neck, is owing to the projection of the larynx forwards in the former situation.

Sheath of vessels. In considering the position of the common carotid artery

with regard to the adjacent structures, it is first to be observed that this vessel is enclosed, together with the internal jugular vein and the vagus nerve, in a common membranous investment or sheath, derived from or continuous with the deep cervical fascia. Separated by means of this sheath from all the surrounding parts, except the vein and nerve just mentioned, the carotid artery is deeply placed at the lower part of the neck, but is comparatively superficial towards its upper end. It is covered below by the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, in addition to the platysma and the different layers of fascia between and beneath the muscles; and it is crossed opposite the lower margin of the cricoid cartilage, or nearly in this situation, by the omo-hyoid muscle. From this last-named point upwards to its bifurcation, the sheath of the vessel is covered by the sterno-mastoideus, by the platysma and fascia, and by the common integument; and this part of the artery lies in a triangular space bounded by the sterno-mastoid, the omo-hyoid, and the digastric muscles [plate 3].

Lower part deeply seated; connections;

Behind, the artery is supported by the cervical vertebræ, from which, however, it is separated by a thin stratum of muscular fibres,—parts of the longus colli and rectus capitis anticus major. From the muscles, as well as from the inferior thyroid artery, and the nerves which rest on those muscles, the vessel is separated by its sheath. In consequence of the contiguity of the bones, the circulation through the carotid artery may be commanded by pressure directed backwards against the vertebral column.

may be compressed against spine.

On the inner side the vessel is in juxtaposition (the sheath only intervening) with the trachea below, and with the thyroid body (which often overlaps the artery), the larynx, and the pharynx higher up. Along its outer side are placed the internal jugular vein and the vagus nerve.

Veins.—The *internal jugular* vein, as already mentioned, lies along the outer side of the artery, and is enclosed in the same sheath, but with a thin partition intervening. The vein is close to the artery at the upper part of the neck [plate 4, fig. 1]; but in approaching the thorax, and on the right side, it inclines outwards, and the two vessels are separated by a triangular interval, across the base of which lies the subclavian artery [plate 2]. A different arrangement obtains on the left side, the vein being nearer to the artery, and even in front at the lower part of the neck [plate 4,

Internal jugular vein. Position to artery; partly different on two sides.

fig. 2]. The inclination of the veins in both these cases is in the same direction—towards the right side, and it may be accounted for by their destination to the right side of the heart: for their tendency to the right side has necessarily the effect of approximating one to, and removing the other from, the artery which it accompanies.

Thyroid veins.

Crossing over the upper part of the common carotid artery to join with the jugular vein, are two or more *superior thyroid veins* [plate 4, fig. 1]. These veins vary in number, and they occasionally form a sort of plexus over the artery. Another vein, likewise from the thyroid body (*middle thyroid vein*), not unfrequently crosses over the artery near the middle [plate 11].

Anterior jugular crosses artery.

The *anterior jugular vein*, after descending along the front of the neck, usually near the middle line, turns outwards under the sterno-mastoid muscle at the lower part of the neck to join the subclavian, and thus crosses the artery [plate 17, fig. 1]. This vein is generally of small size. Occasionally, however, the vein is rather large, and is placed nearly over the carotid artery along the neck [plate 4, fig. 3].

Several nerves near artery.

Nerves.—The descending branch of the hypo-glossal nerve (descendens noni) usually rests on the fore part of the sheath of the carotid artery (together with the branches of cervical nerves which join it) and crosses it from the outer to the inner side [plate 4, fig. 1]. In some instances the branch of the ninth nerve descends within the sheath, and between the artery and vein. The vagus nerve, as already mentioned, lies within the sheath of the vessels between the artery and vein: this nerve was in one case observed to descend over the artery [plate 4, fig. 4]. The sympathetic nerve is placed along the back of the sheath, between it and the muscles, and the recurrent laryngeal nerve crosses inwards behind the sheath.

Usually no branch.

The common carotid artery usually gives off no branch, and therefore continues of equal size in its whole length, except at its bifurcation, where an enlargement is observable.

Peculiarities.—Origin.—The peculiarities affecting the origin of the common carotids of the two sides must necessarily be considered separately.

Origin of right carotid.

The *right carotid* artery, instead of forming one of the branches of the innominate trunk, occasionally arises directly from the aorta, or in conjunction with the left carotid. When it arises from the aorta, it is usually the first vessel from the arch; but it has been found to occupy the second place,—the right subclavian, or, very rarely, the left carotid being the first. These facts are illustrated in op. cit. [plates 6 and 7].

The place at which the right carotid artery commences varies of course with the point of bifurcation of the innominate artery. A change from the usual position (on a level with the upper border of the clavicle) was found in the proportion of about one case in eight and a half; and it was found to occur more frequently above than below that point.

The *left carotid* artery varies in its *origin* much more frequently than the right. In the greater number of its deviations from the ordinary place of origin, this artery arises from, or in conjunction with the innominate artery [plate 6, fig. 7]; and in those cases in which the right subclavian is a separate offset from the aorta, the two carotids most frequently arise by a common trunk [plate 7, fig. 5]. Origin of left carotid varies more than that of right;

The left carotid may be said to have a tendency towards the right side.—Ordinarily placed nearer to the innominate than to the left subclavian, it not unfrequently unites with that (the innominate) artery, as already stated; and it has been observed, very rarely however, to precede the other branches which arise from the transverse part of the aortic arch [plate 7, fig. 2]. On the other hand, the combination of the left carotid with the left subclavian [as shown in plate 6, fig. 9] has been very seldom met with, except in cases of general transposition of the viscera. tendency towards the right part of arch.

Place of division.—The deviations from the usual place of division of the common carotids of both sides of the neck, into the external and internal carotids, may be considered together. The place of division often varies somewhat from the point mentioned as the usual one (the level of the upper margin of the thyroid cartilage), and it more frequently tends upwards than in the opposite direction. The arteries often bifurcate opposite the os hyoides, and occasionally much higher than that bone [plate 12, fig. 1]. On the contrary, the bifurcation from time to time occurs about the middle of the larynx, and (but with much less frequency) opposite the lower margin of the cricoid cartilage [plate 12, fig. 2]. Instances are recorded of the common carotid dividing at a still lower point. One was observed by Morgagni, in which the carotid artery, measuring one inch and a half in length, divided at the root of the neck.* Division more frequently above than below usual place.

The common carotid artery has been found, as a very rare occurrence, to ascend in the neck *without dividing* into its usual terminal branches, —the internal carotid artery being altogether wanting [plate 13, fig. 8]. No division.

In two cases the common carotid artery was absent—the external and internal carotids arising directly from the arch of the aorta. This peculiarity existed on both sides in one of the cases referred to [plate 5, fig. 9], and on one side in the other † [plate 12, fig. 3]. Common carotid absent.

Occasional branches from common carotid.—Though, in the ordinary condition, no branches arise from the common carotid, this is not always the case; for it not unfrequently gives origin to the superior thyroid artery [plate 12, fig. 9], and though very seldom, to a laryngeal, or an inferior thyroid branch [plate 12, fig. 4]. Lastly, the vertebral artery has been observed in a few instances to come from the common carotid [plate 6, fig. 13]. Unusual branches.

* "De Sedibus et Causis Morborum," &c. Epist. 29. Art. 20.
† Dr. Power's case—in "The Arteries," &c., by R. Quain, page 101.

EXTERNAL CAROTID ARTERY.

Size; The external carotid artery (carotis superficialis s. externa, —Haller), fig. 136, *b*, is smaller than the internal carotid in young persons, but the two are about of equal size in the adult. extent; It reaches in the neck from the point of division of the common carotid (opposite the upper margin of the thyroid cartilage) to the neck of the condyle of the lower division; jaw-bone, or a little lower, where it divides into two branches, the temporal and the internal maxillary [plate 8]. This artery diminishes rapidly as it ascends in the neck, owing to the number and size of the branches which spring from it.

why named "external;" At first the external carotid lies nearer to the middle line of the body than the internal carotid,—the distinctive names of the two arteries having reference to their destination to parts nearer or more remote from the surface. Soon after its origin the external carotid crosses over or becomes superficial to the internal, and then curves slightly forwards as it ascends to its place of division. For a short distance connections; after its origin this artery is covered by the sterno-mastoid, by the platysma muscle and the fascia, and is placed in the triangular intermuscular space, bounded by the sterno-mastoid, omo-hyoid and digastric muscles [plate 3]; but it soon becomes deeply placed, passing beneath the stylo-hyoid and digastric muscles, and finally becomes imbedded in the substance of the parotid gland. To the inner side and close to it is the hyoid bone; and farther on, the back of the ramus of the lower maxilla, a portion of the parotid gland being interposed between the bone and the artery. It is close to the pharynx for a short space, and afterwards rests upon the styloid process and the stylo-pharyngeus muscle, which, with the glosso-pharyngeal nerve, are interposed between it and the internal carotid artery.

Veins. *Veins.*—This artery has usually no companion vein, though it may be crossed superficially by small venous branches of the contiguous veins; but when the internal maxillary vein joins the deep instead of the superficial jugular, it accompanies the external carotid.

Nerves. *Nerves.*—Near its commencement the external carotid is crossed by the hypo-glossal nerve [plate 4], and at a short distance from its upper end, in the substance of the parotid gland, by the facial nerve [plate 11]. The glosso-pharyngeal

nerve, as already mentioned, lies between this artery and the internal carotid; and the superior laryngeal nerve is under both vessels.

Peculiarities.—The variations in the place of origin, and consequently in the length of the external carotid artery, are determined by the point of division of the common carotid. With the notice of the peculiarities of the common carotid artery will be found reference to examples of the external carotid taking rise from the arch of the aorta. Origin and length.

BRANCHES OF THE EXTERNAL CAROTID ARTERY.

The external carotid artery gives origin to eight branches, including the two into which it finally divides. For the purposes of description these may be arranged into three sets. 1. Those which are directed forwards, viz. the superior thyroid, the lingual, and the facial. 2. Those which run backwards,—the occipital and posterior auricular. And 3. Those which ascend, viz. the ascending pharyngeal branch, with the temporal and internal maxillary—the two terminal branches. Branches of external carotid artery.

In addition to the principal branches here enumerated, the external carotid gives off several small offsets to the parotid gland.

Peculiarities of the branches.—The peculiarities relating to the origin of the branches of this artery will be mentioned under the description of each: but a general view may be here taken of the deviations they present in respect of position and number. Peculiarities in the branches generally;

Position of branches.—They are not unfrequently crowded together on the parent artery, in some cases near the commencement [plate 12, fig. 6], and in others at a higher point of that vessel [fig. 7]. Occasionally the branches are found to be distributed at regular distances upon the whole length of the external carotid [fig. 8]. in position;

Their number.—The usual number of branches (eight) has been found to be diminished in two principal ways,—viz. by the removal to another artery of one of the ordinary branches, or by the union into a single trunk of two or three branches which are usually derived separately from the artery under consideration. in number; diminished,

The number of branches derived from the external carotid artery may be augmented by the transfer to this vessel of some branch not ordinarily derived from it, or by the addition to it of some unusual branch. Illustrations of these various peculiarities will be referred to in treating of the individual branches. In this place may be mentioned the not unfrequent presence of a distinct branch for the sterno-mastoid muscle. augmented.

SUPERIOR THYROID ARTERY.

The superior thyroid artery, fig. 140, *d*, [plate 8,] the first of the anterior set of branches, is given off close to Superior thyroid;

the commencement of the external carotid, immediately below the great cornu of the hyoid bone. From this point the artery curves forwards and downwards to the upper margin of the thyroid cartilage; it then descends a short distance beneath the omo-hyoid, sterno-hyoid, and sterno-thyroid muscles, furnishing offsets to these muscles, and reaching the anterior surface of the thyroid body, distributes branches to this body, and communicates freely with the branches of the inferior thyroid artery. The inferior thyroid, it will be afterwards seen in the description of the artery, is distributed to the under surface of the thyroid body.

course and position to surrounding parts;

in front of thyroid body.

At first is superficial.

The superior thyroid artery, taking its rise from the external carotid, while that vessel is placed in the triangular intermuscular space referred to in describing the upper part of the common carotid artery, is covered at first only by the platysma and fascia; but afterwards it is more deeply seated, being beneath the muscles before mentioned.

Branches.—Besides the branches furnished to the muscles and the thyroid body, as already noticed, together with some to the lowest constrictor of the pharynx [plate 10], the superior thyroid furnishes the following offsets, which have received distinctive names:

Hyoid branch.

(*a*) The *hyoid*, a very small branch, runs transversely inwards just below the os hyoides, and assists in supplying the soft parts connected with that bone. This little artery sometimes forms an arch with its fellow from the opposite side.

Superficial branch.

(*b*) A *superficial descending* branch, which passes downwards a short distance over the sheath of the large cervical vessels, and ramifies in the sterno-mastoid, and the muscles attached to the thyroid cartilage, as well as in the platysma and neighbouring integuments [plate 4, fig. 1]. The position of this branch with respect to the sheath of the carotid artery is the only circumstance which attaches a degree of interest to it.

Superior laryngeal artery.

(*c*) The *laryngeal* branch (superior laryngeal artery) proceeds inwards in company with the superior laryngeal nerve, and pierces the thyro-hyoid membrane. Before entering the larynx this branch is covered by the thyro-hyoid muscle. On reaching the interior of the larynx, it ramifies in the small muscles, the glands, and mucous membrane of that organ.

Crico-thyroid branch.

(*d*) *Crico-thyroid.*—A small branch, to be noticed on

account of its position rather than its size, crosses over the membrane connecting the thyroid and cricoid cartilages, and communicates with a similar branch from the other side. This little artery may be the source of troublesome hæmorrhage in an operation for laryngotomy.

Peculiarities.—Size.—The superior thyroid artery is frequently much larger, or, on the other hand, it may be smaller than usual. In either case the deviation from the accustomed size is accompanied by an opposite alteration in other thyroid arteries; one change compensating for another.—See observations on the inferior thyroid artery. Peculiarities, size;

Origin.—The superior thyroid is often transferred to the common carotid [plate 12, fig. 9]; and it has been seen, but rarely, conjoined with the lingual branch [plate 13, fig. 1], or with that and the facial branch of the external carotid [fig. 2]. origin.

There are sometimes two superior thyroid arteries. The single vessel has been seen so small that it ended in branches to the sterno-mastoid muscle and the larynx. Two superior thyroids.

Peculiarities of the branches.—The *hyoid* branch is frequently very small or absent.

The *laryngeal* branch arises not unfrequently from the external carotid artery, and likewise, but rarely, from the common carotid. Laryngeal branch: unusual states of.

Examples have occurred of this branch being of very large size [plate 23, fig. 6]. In the case here referred to, the laryngeal artery, after passing along the inner side of the thyroid cartilage, escaped beneath that cartilage to the thyroid body.

The laryngeal artery occasionally enters the larynx through a foramen in the thyroid cartilage [plate 13, fig. 4]; and it has likewise been observed to pass inwards below the cartilage, [fig. 5,] afterwards distributing branches upwards to the interior of the larynx.

LINGUAL ARTERY.

The *lingual artery*, fig. 140, *e*, [plate 8,] arises from the inner side of the external carotid, between the origin of the superior thyroid and facial arteries. Curving from its origin upwards and inwards, this artery reaches the upper margin of the hyoid bone (its greater cornu), by which it is separated from the superior thyroid artery; it then passes forwards deeply between the muscles above the hyoid bone, and soon ascends almost perpendicularly to reach the under surface of the tongue, beneath which it makes its final turn forwards to the tip of that organ, assuming the name of ranine artery. Lingual artery; curved course;

Taking origin in the triangular intermuscular space in which the commencement of the external carotid artery is lodged, the lingual artery is at first comparatively superficial, covered only by the platysma and fascia of the neck; soon, however, it is crossed by the digastric and stylo- at first nearly superficial;

then deep seated.

hyoid muscles, and then sinks beneath the hyo-glossus muscle, between it and the middle constrictor of the pharynx, resting against this last and the genio-hyo-glossus.

Nerves.

The hypo-glossal nerve courses forwards nearly parallel with the artery, until they both reach the posterior border of the hyo-glossus muscle, where the nerve crosses the artery and passes over or on the cutaneous surface of the muscle,—the artery being beneath. At the anterior margin of the hyo-glossus muscle the nerve is lower than the artery.

Branches;

The *branches* of the lingual artery, including the *ranine*, are as follow:—

hyoid.

The *hyoid* branch takes the direction of the hyoid bone, running along its upper border; it supplies the contiguous muscles and skin.

Dorsal artery of tongue.

The *dorsal artery of the tongue* (dorsalis linguæ), which is often represented by several smaller branches, arises from the deep portion of the lingual artery beneath the hyo-glossus muscle. It is named *dorsal* from its destination, for it ascends to supply the upper part and the substance of the tongue, ramifying as far back as the epiglottis.

Sublingual artery;

supplies gland.

The *sublingual* branch, taking origin at the anterior margin of the hyo-glossus, turns slightly outwards beneath the mylo-hyoid muscle, between this and the sublingual gland. It supplies the substance of the gland, and gives branches to the mylo-hyoid and other muscles connected with the maxillary bone. Small branches are also distributed to the mucous membrane of the mouth, and the inside of the gums.

Ranine artery,

under mucous membrane.

The *ranine* artery may be considered from its direction the continuation of the lingual artery. It runs forwards beneath the tongue, covered by the mucous membrane, and resting on the genio-hyo-glossus muscle. Having reached the tip of the tongue, which it supplies with blood, it anastomoses with the corresponding artery of the other side. The two ranine arteries are placed one on each side of the frænum of the tongue, covered only by the mucous membrane of the mouth.

Peculiarities of lingual;

Peculiarities.—The origin of the lingual artery has sometimes a common trunk with the next branch above it, viz. the facial artery [plate 13, fig. 4]. It is occasionally joined with the superior thyroid.

hyoid.

Branches.—The *hyoid* branch is often deficient; and it appears that

there is an inverse condition as to size between this branch and the hyoid branch of the superior thyroid.

The *sublingual* branch varies in size. It is sometimes derived from the facial artery, and then perforates the mylo-hyoid muscle. Sublingual,

The lingual artery has been seen to give off as *unusual* branches, the submental and ascending palatine. unusual branches.

FACIAL ARTERY.

The facial artery (art. maxillaris externa. — Anatom. varior.: labialis,—Haller), fig. 140, *f* [plate 8].—This artery is named from the distribution of its greater part. Taking origin a little above the lingual artery, it is first directed obliquely forwards and upwards beneath the base of the maxillary bone; and this may be considered the cervical part of the artery. Changing its direction, it passes upwards over the base of the lower maxilla, at the anterior margin of the masseter muscle which covers the ramus. Commencing here its course upon the face, the facial artery is directed forwards near to the angle of the mouth; and after ascending externally to the nose, terminates near the inner canthus of the eye, where it anastomoses with the ophthalmic artery. In its whole course the artery is tortuous; and this condition is connected in the neck with the changes in size to which the pharynx is liable, and on the face with the mobility of the cheeks and the lower maxilla. Facial artery; course in neck; over maxilla; upon the face; is tortuous throughout.

The cervical part of the facial artery immediately after its origin (which is comparatively superficial, being covered only by the platysma and fascia), sinks beneath the digastric and stylo-hyoid muscles, and then beneath the submaxillary gland near the upper part. Emerging from the gland and ascending over the maxilla, it is covered by the platysma, and here the pulsation of the artery is easily felt, and the circulation through it readily controlled by pressure against the bone. In its farther progress over the face, the facial artery is covered successively (in addition to the integument and a varying quantity of fat) by the platysma and the zygomatic muscle, and it rests against the buccinator, the levator anguli oris, and the levator labii superioris. Connections in neck; may be compressed on maxilla. Connections on face.

The facial *vein* is separated by a considerable interval from the artery on the face. It takes nearly a straight course upwards, instead of inclining forwards near the angle of the mouth, and it is not tortuous like the artery. Facial vein;

Branches of the portio dura nerve cross the vessel; and the infraorbital nerve is beneath it, separated by the fibres of the elevator of the upper lip. nerves.

Branches.

Branches.—The branches of the facial artery are numerous, and may be divided conveniently into two sets,—the first consisting of those given off before the vessel turns over the lower maxillary bone (cervical branches), usually three or four in number; the second, which varies from five to six, being those distributed to the face (facial branches).

Cervical branches.

Cervical branches.—The following branches are derived from the facial artery below the maxillary bone:

Ascending palatine; distributed to tonsil, side of pharynx and palate.

The *inferior* or *ascending palatine* (palatine adscendens,—Haller), [plate 15, fig. 1,] ascends between the stylo-glossus and stylo-pharyngeus muscles, and reaches the pharynx close by the border of the internal pterygoid muscle. After having given small branches to the tonsil, the styloid muscles, and the Eustachian tube, it divides near the levator palati muscle into two branches; one of which follows the course of the circumflexus palati muscle, and is distributed to the soft palate and its glands, whilst the other penetrates to the tonsil, and ramifies upon it with the branch to be next described.—The place of this artery upon the palate is often taken by the ascending pharyngeal. For the distribution of the vessels in that case, see the ascending pharyngeal artery.

Tonsillar branch.

The *tonsillar* branch ascends along the side of the pharynx, and penetrating the superior constrictor of the pharynx, terminates in small vessels upon the tonsil and the side of the tongue near its root.

Branches to gland.

The *glandular* branches are a numerous series which enter the substance of the submaxillary gland, whilst the artery is in contact with it; some of them are prolonged upon the side of the tongue.

Submental; below base of jaw.

The *submental* (submentalis arteria,—Haller), fig. 140, *g* [plate 8], the largest branch arising from the facial in the neck, leaves that artery near the point at which this turns upwards to the face, and runs forwards below the base of the maxillary bone upon the mylo-hyoid muscle and beneath the digastric. Giving branches in its course to the submaxillary gland and the muscles attached to the jaw, it reaches the symphysis of the chin and divides into two branches; one of these, running more superficially than the other, passes between the depressor muscle of the lower lip and the skin, supplying both; whilst the other enters between that muscle and the bone, and ramifies in the substance of the lip, communicating with the inferior labial artery, which is to be next described.

Facial branches.—Of the second series of branches,—those derived from the facial artery upon the side of the face,—some are directed outwards to the muscles, as the masseter and buccinator, and require only to be indicated. Those which are described with some detail have the opposite course inwards, and they are as follows :— **Branches on face.**

The *inferior labial* branch arises immediately after the facial artery has turned over the maxilla, and running forwards beneath the depressor anguli oris, distributes branches to the skin and the muscles of the lower lip, anastomosing with the inferior coronary and submental branches, and with the inferior dental branch derived from the internal maxillary. **Inferior labial.**

The *coronary artery* of the lower lip (coronaria labri inferioris,—Haller) arises near the angle of the mouth, as often in conjunction with the superior coronary as from the facial separately, and after penetrating the muscular fibres surrounding the orifice of the mouth, takes a transverse and tortuous course between those fibres and the mucous membrane of the lip, and inosculates with the corresponding artery of the opposite side. Small branches from this artery ascend to supply the orbicular and depressor muscles, the glands, and other structures of the lower lip; whilst others descend towards the chin, and communicate there with branches from other sources. **Inferior coronary; under muscle; joins with opposite artery.**

The *coronary artery* of the upper lip,* (coronaria labri superioris,—Haller) *i*, is larger and more tortuous than the preceding branch with which it often arises. Like the lower coronary artery, it runs across between the muscles and mucous membrane of the upper lip, and inosculates with its fellow of the opposite side. In addition to supplying the whole thickness of the upper lip, this artery gives two or three small branches to the nose. One of these, named the *artery of the septum*, runs along the septum nasi, on which it ramifies as far as the point of the nose; another reaches the ala of the nose. **Superior coronary; joins with opposite; artery of septum nasi.**

* The name *coronary* artery of the upper and lower lips respectively (coronaria labri superioris v. inferioris), is stated by Haller to have been taken by him from Winslow. But this anatomist, ("Anatomical Exposition," &c., sect. 4, 56, translated by Douglas,) after describing the course of the arteries, concludes by mentioning that they anastomose one with the other "and thereby form a kind of arteria coronaria labiorum." So that the designation originally, and not inaptly, applied to the circle formed by the union of the labial arteries of opposite sides around the mouth, has come to be used for each vessel singly.

Lateral artery of nose.

The *lateral nasal artery* turns inwards to the side of the nose beneath the common elevator of the nose and lip, and sends branches to the ala and the dorsum of the nose. This artery anastomoses with the nasal branch of the ophthalmic, with the artery of the septum nasi, and with the infra-orbital artery.

Angular artery.

Angular artery.—Under this name is recognised the end of the facial vessel, which inosculates at the inner side of the orbit with the ophthalmic artery. It is accompanied by a considerable vein (the angular vein).

Facial. Communicates between superficial and deep arteries.

It may here be remarked, that a communication between the superficial and deep branches of the external carotid is established by the anastomoses of the facial artery with the infraorbital, buccal, inferior dental, and nasal branches of the internal maxillary; and between the external and the internal carotids by the anastomoses of the facial with the ophthalmic arteries.

Peculiarities of facial;

Peculiarities.—Origin.—The facial artery not unfrequently arises by a common trunk with the lingual [plate 13, fig. 4]. Occasionally it arises above its usual position, and then descends beneath the angle of the jaw to assume its ordinary course [plate 13, fig. 5].

size;

deficiencies, how supplied.

This artery varies much in *size*, and in the extent to which it is distributed. It has been observed, very rarely however, to end as the submental, not reaching the side of the face; in some cases it supplies the face only as high as the lower lip. The deficiency of the facial artery is most frequently compensated for by an enlargement of the nasal branches of the ophthalmic at the inner side of the orbit [plate 14, fig. 3]; occasionally by branches from the transverse facial [fig. 2], or internal maxillary [fig. 1].

Branches.

Branches.—The *ascending palatine* artery is in some instances transferred to the external carotid. This branch varies in size and the extent to which it reaches. Not unfrequently it is expended without furnishing any branch to the soft palate. When it is thus reduced in size, the pharyngeal artery takes its place on the soft palate. —(See the observations on the pharyngeal artery.)

The *tonsillar* branch is not unfrequently altogether wanting.

The *submental* branch has been observed to take its rise from the lingual artery. On the other hand, the facial artery, instead of the lingual, has been found to furnish the branch which supplies the sublingeal gland.

OCCIPITAL ARTERY.

Occipital artery,

winding course;

The occipital artery, fig. 140, *m*, *m*, has a long and winding course, running at first deeply upwards before the upper cervical vertebræ, then horizontally along the outer part of the base of the skull, and finally turning upwards on the occiput beneath the integument. Arising from the posterior part of the external carotid usually opposite the facial

artery, this vessel in its upward course [plate 16] sinks beneath the posterior belly of the digastric muscle and the parotid gland, and reaches the interval between the transverse process of the atlas and the mastoid process of the temporal bone. From that point it turns horizontally backwards along the skull, beneath the mastoid process of the temporal bone and the sterno-mastoid, splenius, digastric, and trachelo-mastoid muscles [plate 19]. In this part of its course the vessel rests against the upper end of the complexus, by which and by the fibres of the superior oblique and larger rectus muscles, it is separated from the occipital bone. Lastly, changing its direction a second time, and piercing the cranial attachment of the trapezius, it ascends beneath the integument on the back of the head accompanied by the great occipital nerve, and divides into numerous branches. Whilst in the neck, the occipital artery crosses over the internal carotid artery, the vagus and spinal accessory nerves, and the internal jugular vein ; and the hypo-glossal nerve turns from behind over it at its origin.

course in neck ;

along base of skull ;

on occipital bone.

The following *branches* are given from the occipital artery: Branches :

Small *muscular* offsets to the digastric and stylo-hyoid muscles, and one of larger size to the sterno-mastoid. This last is so regular a branch that it is known as the *sterno-mastoid* branch. Muscular. Sterno-mastoid.

An *auricular* branch to the back part of the concha of the ear, and two or three other muscular branches to the splenius and trachelo-mastoid. Auricular.

Cervical branch.—(Ramus princeps cervicalis,—Haller.)— To the back part of the neck the occipital artery furnishes a branch thus designated. Descending a short way, this vessel divides into a superficial and a deep branch. The former ramifies beneath the splenius, sending offsets through that muscle to the trapezius ; while the deep branch passes beneath the complexus, and anastomoses with the vertebral and the deep cervical branch of the superior intercostal [plate 18, fig. 1]. The muscles in the immediate neighbourhood are furnished with small arteries from the cervical branch of the occipital.—The size of this branch varies very much. Cervical.

The *meningeal* branch runs up with the internal jugular vein, enters the skull through the foramen jugulare, and ramifies in the dura mater of the posterior fossa of the base of the skull. Meningeal.

The *superficial* or cranial branches of the occipital artery Superficial

or terminal branches. pursue a tortuous course between the integument and the occipito-frontalis muscle ; and in proceeding upwards on the skull they separate into diverging branches, which communicate with the branches of the opposite artery, as well as with those of the posterior auricular artery, and of the temporal artery at the vertex and side of the skull. Branches are distributed to the fleshy fibres of the occipital muscle, to the epicranial aponeurosis, and to the pericranium ; others to the skin ; and one (a *mastoid* branch) enters the skull through the mastoid foramen, and ramifies in the dura mater.

Peculiarities; origin; *Peculiarities.*—The *origin* of the occipital, though usually opposite the facial, is sometimes placed higher or lower than that point. This artery is occasionally derived from the internal carotid [plate 14, fig. 6], and from the ascending cervical branch of the inferior thyroid—an offset of the subclavian artery [plate 24, fig. 3].

course; The occipital artery sometimes passes over the trachelo-mastoid muscle, instead of beneath it. The chief portion of the vessel was found, in but a single instance however, to pass over the sterno-mastoid muscle, only a small artery being placed in the usual position [plate 14, fig. 5]. The artery has, in a few instances, been seen to turn backwards *below* the transverse process of the atlas [plate 24, fig. 3].

branches. *Branches.*—The posterior auricular and the pharyngeal arteries sometimes take origin from the occipital.

POSTERIOR AURICULAR ARTERY.

Posterior auricular; The posterior auricular artery, a small vessel, arises from the carotid a little higher up than the latter. It ascends, under cover of the parotid gland, and resting on the styloid process of the temporal bone, to reach the angle formed by the cartilage of the ear with the mastoid process. The portio dura of the seventh nerve crosses over this little artery, and the spinal accessory nerve behind it. Somewhat above the mastoid portion of the temporal bone it divides, fig. 140, *o*, into two sets of branches, of which one set inclines forwards to anastomose with the posterior branch of the temporal artery, and the other backwards towards the occiput, on which it communicates with the occipital artery. anastomoses.

The following are the *branches* given from the posterior auricular artery.

Branches: Several small branches to the parotid gland and the digastric muscle.

Stylo-mastoid. The *stylo-mastoid* branch enters the foramen of that name in the temporal bone; on reaching the tympanum, it divides

into delicate vessels, which pass, some to the mastoid cells, others to the labyrinth. One branch will constantly be found in young bodies to form, with the tympanic branch of the internal maxillary artery which enters the fissure of Glaser, a vascular circle around the auditory meatus, from which delicate offsets ramify upon the membrana tympani. This small tympanic branch sometimes arises from the occipital artery. Tympanic branch.

As it passes the back of the ear, the auricular artery gives one or two special *auricular* branches, which supply the posterior surface of the concha, and turn over the margin, or perforate the substance of the auricle to gain the anterior surface. Auricular.

Peculiarities.—The posterior auricular artery is frequently very small, and has been seen to end in the stylo-mastoid branch. It is often a branch of the occipital.

Sterno-mastoid Artery.—Associated by its position with the posterior branches of the external carotid, viz. occipital and posterior auricular, a small vessel named from its destination *sterno-mastoid*, is not unfrequently met with. Sterno-mastoid branch.

TEMPORAL ARTERY.

The temporal artery, fig. 140, *p*, [plate 16,] is one of the two branches into which the external carotid artery divides a little below the condyle of the lower jaw; this continues upwards in the direction of the parent vessel, whilst the other branch (the internal maxillary) sinks under the lower maxillary bone. The temporal artery is at first imbedded in the substance of the parotid gland, where it lies in the interval between the meatus of the ear and the condyle of the lower jaw. Pursuing its course upwards, this vessel soon reaches the cutaneous surface of the zygoma (at the root), on which it may be readily compressed. Continuing to ascend [plate 8], it lies close beneath the skin, supported by the temporal muscle and fascia; and, about two inches above the zygoma, divides into two branches, which again subdivide and ramify beneath the integument on the side and upper part of the head. Temporal artery; course.

The temporal artery gives off the following *branches:* Branches

Several small offsets to the parotid gland; some articular branches to the articulation of the lower jaw; and one or two branches to the masseter muscle. Parotid. Articular. Masseteric.

Transverse facial.

The *transverse* artery of the face, *q* (transversalis faciei), arises whilst the temporal artery is deeply seated in the parotid gland, through the substance of which it runs forwards; getting between the parotid duct and the zygoma, it rests on the masseter muscle, and is accompanied by one or two transverse branches of the facial nerve. It gives small vessels to the parotid gland, the masseter muscle, and the neighbouring integument; and divides into three or four branches, which are distributed to the side of the face, anastomosing with the infra-orbital and facial arteries.

Middle temporal.

The *middle temporal* branch arises close above the zygoma, and immediately perforating the temporal fascia, sends branches to the temporal muscle, which communicate with the deep temporal branches of the internal maxillary artery. An offset from this artery runs on to the outer angle of the orbit, where it gives branches to the orbicularis palpebrarum.

Anterior auricular.

The *anterior auricular* branches, two or more in number (superior and inferior), arise above the branch last described. They are distributed to the forepart of the pinna, the lobe of the ear, and a part of the external meatus, anastomosing with the ramifications of the posterior auricular artery.

Anterior temporal.

One of the two terminal branches of the temporal artery, the *anterior temporal*, inclines forwards as it ascends over the temporal fascia, and ramifies extensively over the forehead, supplying the orbicular and occipito-frontal muscles, the pericranium, and the skin, and communicating with the supra-orbital and frontal branches of the ophthalmic artery. On the upper part of the cranium the branches of this artery are directed from before backwards.—When it is desired to take blood from the temporal artery, the anterior temporal branch is selected for the operation.

Arteriotomy.

Posterior temporal.

The *posterior temporal*, which is larger than the anterior, passes back on the side of the head, above the ear, and over the temporal fascia; its branches ramify freely in the coverings of the cranium, both upwards to the vertex, where they communicate with the corresponding vessel on the opposite side, and backwards to join with the occipital and posterior auricular arteries.

Peculiarities of temporal artery.

Peculiarities.—The temporal artery is frequently tortuous, especially in aged persons. Occasionally a large unusual branch runs forward above the zygoma to the upper part of the orbit [plate 14, fig. 4]. The temporal artery may join with the ophthalmic, and furnish large

frontal arteries.—The *transverse artery of the face* varies in size; occasionally it is much larger than usual, and takes the place of a defective facial artery [plate 14, fig. 2]. In some instances the transverse artery is transferred to the external carotid.

INTERNAL MAXILLARY ARTERY.

Internal maxillary artery;

The internal maxillary artery, fig. 141, *a*, the deep terminal branch of the external carotid, A, and which in size, though not in direction, is the continuation of that vessel, pursues a winding course under cover of the ramus of the lower maxilla. From its place of origin, where it is concealed by the parotid gland, the artery curves forwards [plate 9] and assumes for a short space a horizontal course, sinking immediately under the maxilla, between that bone and the internal lateral ligament of the temporo-maxillary joint: and here it lies below the narrow end of the external pterygoid muscle, and crosses over the inferior dental nerve. Speedily changing its course, the internal maxillary artery passes obliquely forward and upward over the outer surface of the same muscle (not unfrequently beneath it), and under cover of the ramus of the lower maxilla, and of the lower end of the temporal muscle. Approaching the superior maxillary bone, and opposite the interval between the two heads of the external pterygoid muscle, the artery bends inwards to the spheno-maxillary fossa, where it furnishes the terminal branches.

Fig. 141.

course; near the ramus of lower jaw; among the muscles; near the superior maxilla.

Divided into three portions.

For the sake of greater facility in arranging the numerous branches furnished by this artery, it will be considered as divisible into three parts, each giving origin to a group of branches. The first portion is that short part connected with the ramus of the lower maxilla, and placed between that bone and the internal lateral ligament of the temporo-maxillary articulation; the second is defined by the connection of the vessel with the muscles; while the third

division includes that portion which is again in close connection with bone, viz. with the superior maxilla and the fossa which it contributes to form.—It is to be understood that this, like most other methods of merely artificial arrangement, is not free from objection.

ranches: first series. A. The branches given from the first part of the internal maxillary artery,—that between the lower maxilla and the lateral ligament of the joint,—are the tympanic, the middle and small meningeal, and the inferior dental, each of which, it may be observed, passes into an osseous foramen or canal.

Tympanic. The *tympanic branch* passes deeply behind the articulation of the lower jaw, and enters the fissure of Glaser, supplying the laxator tympani muscle, and the tympanic cavity, where it ramifies upon the membrana tympani. It anastomoses in the tympanum with the stylo-mastoid and Vidian arteries. This little artery varies in its place of origin in different cases.

Middle meningeal; The *middle meningeal* or *great* meningeal artery, fig. 141, *b*, is by far the largest of the branches which supply the dura mater. It arises from the internal maxillary artery between the lateral ligament and the lower jaw, and passes directly upwards under cover of the external pterygoid muscle to the spinous foramen of the sphenoid bone. enters skull, Through that foramen it reaches the interior of the skull, where it ramifies between the dura mater and the internal surface of the cranial bones, its numerous ramifications spreading over the sides and top of the cranium, along the deep arborescent grooves formed on the inner surface of the bones. In its course within the cranium the middle meningeal artery ascends along the middle fossa of the skull to in grooves of bone. the anterior inferior angle of the parietal bone, where it becomes lodged in a deep groove—sometimes in a distinct canal in that bone. From this point it divides into numerous branches, which spread out, some upwards over the parietal bone as high as the vertex, and others backwards even to the occipital bone.

Immediately after it has entered the cavity of the cranium the middle meningeal artery gives minute branches to the ganglion of the fifth nerve, and to the dura mater near the Petrosal branch. sella Turcica. One small branch (petrosal branch: artery of the facial nerve,—Cruveilhier) runs backwards and outwards over the petrous portion of the temporal bone, enters the hiatus Fallopii, and passes along the aqueduct, sending

offsets which anastomose with the stylo-mastoid artery. As it ascends through the middle fossa of the skull, the middle meningeal artery sends branches which extend forwards to the orbit, and are found to inosculate with the lachrymal, or some other branch of the ophthalmic artery.—The branches of this artery supply the bones as well as the dura mater, to which membrane they adhere closely when the skull is detached from it. Meningeal artery supplies bones.

The middle meningeal artery is accompanied by two veins. Two veins.

The *small meningeal* artery, *c*, sometimes arises from the preceding branch. It enters the skull through the foramen ovale, to supply the dura mater in the middle fossa. Small meningeal.

The *inferior maxillary, or dental artery*, *d*, *d*, descends to enter the dental canal, accompanied by the inferior dental nerve, and then runs along the canal together with the nerve as far forwards as the labial foramen, through which it escapes on the face. As it enters the foramen in the lower maxilla this artery gives off the *mylo-hyoid* branch, which with nerve runs in a groove below the dental foramen, and ramifies on the under surface of the mylo-hyoid muscle. Inferior maxillary;

In its course through the bone the inferior dental artery lies beneath the roots of the teeth, and gives off at intervals small offsets, which ascend to enter the minute apertures in the extremities of the fangs, and supply the pulp of each tooth. From the labial foramen a branch is continued forwards beneath the incisor teeth, supplying them with minute vessels, and inosculating at the symphysis of the chin with a corresponding artery from the opposite side. The terminal or facial branches of the inferior dental artery anastomose on the face with the inferior coronary and submental arteries, and assist in supplying the soft parts covering the front of the lower jaw. supplies lower teeth, and appears on the chin.

B. The second group of branches—those given from the internal maxillary artery whilst it is in connection with the muscles, are, the deep temporal, the pterygoid, the masseteric, and the buccal,—that is to say, the branches which supply the muscles. Second series of branches;

The *deep temporal* branches, *c*, two in number (anterior and posterior), ascend between the temporal muscle and the cranium [plate 8], along which they ramify, supplying that muscle, and anastomosing with the branches of the other temporal arteries, and with minute branches of the lachrymal artery, through small foramina in the malar bone deep temporal.

nasi, between the mucous membrane and the periosteum, to the fore part of the nasal fossa, where it ends in a small vessel which enters the incisor foramen, and joins an ascending branch from the descending palatine artery.

Peculiarities; origin; *Peculiarities.*—The internal maxillary artery is very constant in its *place of origin.* It has however been seen to arise from the facial [plate 13, fig. 6].

But this artery often deviates from the *course* described as the more usual one—passing under cover of the external pterygoid muscle, and crossing the third trunk of the fifth nerve. In this case the artery comes forward in the interval between the two heads of the muscle to its accustomed position near the superior maxillary bone [plate 13, fig. 7]. It course under external pterygoid. has likewise been observed to escape from under cover of the external pterygoid by piercing the middle of that muscle. When the artery is placed beneath the muscle, it has been found lodged in a notch in the posterior margin of the external pterygoid plate, and bound down by fibrous structure. In the process of bone referred to, instead of a depression there is occasionally a foramen, which probably lodges the artery.

Branches. The *branches* of the internal maxillary artery present few peculiarities worthy of note.

Middle meningeal. The *middle meningeal* artery occasionally furnishes the lachrymal artery (usually an offset of the ophthalmic),—a peculiarity which may be looked on as resulting from the enlargement of an ordinary anastomosing branch.

In a case in which the internal carotid was wanting, two tortuous branches from the internal maxillary entered the foramen rotundum and foramen ovale, to supply its place [plate 13, fig. 8].

PHARYNGEAL ARTERY.

Ascending pharyngeal; The pharyngeal artery, fig. 140, *k*, a long slender vessel, (the smallest branch of the external carotid which has received a distinctive designation,) ascends deeply in the course. neck, and lies concealed from view until some of the branches of the external carotid artery and the stylo-pharyngeus muscle are drawn aside [plate 15, fig. 1]. It arises most commonly from half an inch to an inch above the origin of the external carotid; and in its straight course upwards rests on the rectus capitis anticus, close to the surface of the pharynx, between it and the internal carotid artery, and is thus directed up towards the base of the Branches: skull. Its branches, which are necessarily very small, may, from a consideration of their destination, be divided into three sets, viz., those to the pharynx: a set directed outwards: and meningeal branches.

Pharyngeal; The *pharyngeal* branches pass inwards for the most part to the pharynx. One or two small and variable branches

ramify in the middle and inferior constrictors. Higher up than these is a larger and more regular branch, which runs upon the upper constrictor, and sends small ramifications to the Eustachian tube, and the soft palate and tonsil.

The last-named, or *palatine* branch, is sometimes of considerable size, and supplies the soft palate, taking the place of the inferior palatine branch of the facial artery, which, in such cases, is small. The arrangement of this artery of the palate is as follows. After passing above the superior constrictor it divides into two branches; of which one arches across the upper part of the soft palate, running beneath the mucous membrane on the front, whilst the other and larger branch is disposed in a similar manner near the free margin of the palate; both vessels anastomosing with those of the opposite side. Other small branches likewise ramify beneath the mucous membrane behind the velum palati. **may take place of inferior palatine; course on the soft palate.**

The *external* branches of the pharyngeal artery consist of several small and irregular vessels, which are distributed to the following parts, viz.—the rectus anticus muscle, the first cervical ganglion of the sympathetic nerve, some of the cerebral nerves as they issue from the skull, and the lymphatic glands of the neck. Some of them anastomose with the ascending cervical branch of the subclavian artery. **External branches to nerves.**

The *meningeal* branches, the terminal branches of the ascending pharyngeal artery, are those which pass through the foramina at the base of the skull: one or two of them accompany the internal jugular vein through the foramen jugulare; whilst another, which passes through the foramen lacerum (basis cranii), enters the cranial cavity, and is distributed to the dura mater. **Meningeal.**

Peculiarities.—The place of origin of the pharyngeal from the external carotid artery varies considerably. It is not unfrequently distant from the commencement of the external carotid less than half an inch, or more than one inch (the limits within which it has been stated to take its origin in most cases); and it is occasionally found to spring from the bifurcation of the common carotid. Morever, examples from time to time present themselves of this artery being given from an unusual source—as from the occipital or the internal carotid artery [plate 15]. **Peculiarities; origin.**

Two pharyngeal arteries have been observed in a few instances [plate 13, fig. 1]. **Sometimes double.**

INTERNAL CAROTID ARTERY.

The internal carotid artery (carotis interna, v. cerebralis) is that branch of the common carotid which is distributed to **Internal carotid;**

supplies brain and orbit; the brain, and to the eye with its appendages. It extends from the place of bifurcation of the common carotid, usually in a straight direction, to the base of the skull, where it course. ascends in a winding course through the temporal bone, and after entering the cranial cavity, ends by the side of the anterior clinoid process of the sphenoid bone.

Three parts. The internal carotid artery may thus be conveniently studied in three parts of its course, viz. while in the neck; in passing through the carotid canal in the base of the skull; and within the cavity of the cranium.

In the neck; *Cervical part.*—In the neck the artery, fig. 140, *c*, commencing at the bifurcation of the common carotid opposite the upper border of the thyroid cartilage, ascends nearly vertically to the base of the skull to reach the carotid foramen in the temporal bone. Like the common carotid it is accompanied in this course by the internal jugular vein on its external side.

length; This portion of the artery varies much in length. The length in different persons is in general dependent on the stature; but it is also materially influenced by the extent to which the common carotid reaches upwards in the neck, and the length of the internal carotid may be said to be inversely as the length of that vessel [plate 12, fig. 1 and 2]. At first the internal carotid is easily accessible in the neck, at first near the surface, inasmuch as it is placed in the intermuscular space, in which the division of the common carotid artery occurs [plate 3], and is covered only by the sterno-mastoideus and to outer side of external carotid; platysma and fascia, besides its sheath. Placed here to the outer side of the external carotid artery, it soon sinks beneath the parotid gland, and becomes deep-seated as it soon gets deep; turns under the external carotid. In its course upwards parts in contact; the internal carotid is crossed by the hypo-glossal nerve, and the digastric and stylo-hyoid muscles, as well as by the external carotid and occipital arteries. Higher up, and under cover of the parotid gland, the vessel is likewise crossed by the stylo-pharyngeus muscle, together with the glosso-pharyngeal nerve,—these structures being interposed between it and the external carotid artery [plate 10].

close to pharynx and tonsil. Behind, this artery rests against the rectus anticus major, which muscle, with the sympathetic and vagus nerves, is placed between it and the transverse processes of the upper cervical vertebræ: the pharynx and the tonsil, with the pharyngeal artery, are on its inner side.

On reaching the base of the skull the internal carotid,

following the direction of its special canal in the petrous portion of the temporal bone, ascends perpendicularly a little way, then inclines forwards and inwards near the inner side of the Eustachian tube, and again ascends as it escapes from the carotid canal. Whilst within the canal the artery has in contact with it the carotid plexus of nerves.

In carotid canal; curves.

Fig. 142.

In cranium;

On passing out of its canal in the temporal bone the artery, now within the skull, ascends a short distance towards the body of the sphenoid bone, where it enters the cavernous sinus, having perforated the layer of dura mater which forms the outer boundary of that cavity. Then, still contained within the sinus and, according to some anatomists, invested by the lining membrane, it runs horizontally forwards along the side of the sphenoid bone which is grooved for its reception, and again curves upwards beneath the anterior clinoid process; piercing at this spot the upper or cerebral wall of the cavernous sinus, and becoming invested by the arachnoid membrane, it reaches the inner end of the fissure of Sylvius, and divides into its terminal branches. Whilst the internal carotid artery is within the cavernous sinus, it is crossed on the outer side by the following nerves, viz., the third, fourth, ophthalmic division of the fifth, and the sixth.

enters cavernous sinus;

ends at fissure of Sylvius.

Peculiarities.—The variations which occur in the length of the internal carotid artery have been already noticed. Independently of the position at which it is given off in the neck from the bifurcation of the common carotid artery, the only change which has been observed in its place of origin is that met with in those very rare cases already referred to (page 233), in which there was no common carotid artery—the external and internal carotids being both derived directly from the arch of the aorta. In these cases the internal carotid artery was nearer to the trachea than the external carotid, the latter curving forwards over the internal carotid opposite the larynx.

Variations.

Origin from aorta to inner side of external carotid.

Often curved in neck.

Instead of following a straight direction upwards in the neck, the internal carotid is often curved; and in one case it was observed, after having reached nearly to the base of the skull, to turn downwards for more than an inch, and then abruptly to ascend again, being thus twice closely curved or folded on itself.

Absence of internal carotid.

A very few examples are recorded of entire absence of the internal carotid [op. cit. pp. 48, 160]. In one of these cases [plate 13, fig. 8], the common carotid ascended in the neck, gave off all the usual branches of the external carotid, and divided into the temporal and internal maxillary arteries. Supplying the place of the internal carotid, were two tortuous trunks from the internal maxillary, which entered the skull respectively through the oval and the round formina in the sphenoid bone, and united into a single vessel. The vessel thus formed was smaller than the ordinary internal carotid, but the internal carotid of the opposite side was larger than usual.

BRANCHES OF THE INTERNAL CAROTID ARTERY.

Branches: none in the neck; in the bone tympanic. Arteriæ receptaculi.

In the neck the internal carotid artery gives usually no branch. Whilst within the carotid canal it sends a small offset to the tympanum, which anastomoses with the tympanic and stylo-mastoid arteries. Within the cavernous sinus some small branches, named *arteriæ receptaculi*, proceed from it to supply the walls of the sinus and the adjacent dura mater.

Ophthalmic and cerebral.

Opposite the anterior clinoid process the artery gives off the ophthalmic branch, and at the Sylvian fissure of the brain it divides into the anterior cerebral, the middle cerebral, and the posterior communicating arteries.

OPHTHALMIC ARTERY.

Ophthalmic artery; with optic nerve.

The *ophthalmic* artery, fig. 142, *b*, passes forwards from the internal carotid artery by the side of the anterior clinoid process, and enters the orbit by the foramen opticum, placed below and to the outer side of the optic nerve. It soon changes its direction, passing above and to the inner side of the nerve, to reach the inner wall of the orbit, along which it runs forwards, and terminates in branches which ramify on the side of the nose.

Branches.

In its course the ophthalmic artery gives off numerous *branches*, which are destined to supply the eye and its appendages. They are as follows:—

Lachrymal.

The *lachrymal* artery, *c*, the first of the branches of the ophthalmic, is a long branch which arises from that vessel on the outer side of the optic nerve. It passes forwards beneath the periosteum of the roof of the orbit, along the upper border of the external rectus muscle, and guided by it to the lachrymal gland, in which the greater number of

its branches are distributed. Some of the branches pass onwards to the eyelids and conjunctiva, joining with other palpebral branches; and one or two delicate vessels, *malar* branches, pierce the malar bone and reach the temporal fossa, where they join branches from the deep temporal arteries. The lachrymal artery has also branches of communication through the sphenoidal fissure with small offsets from the middle meningeal artery.

The *central artery of the retina*, a very small vessel, pierces the sheath and substance of the optic nerve, and runs imbedded within this to the retina, in which it ramifies in minute branches. A very delicate vessel, demonstrable in the fœtus, passes forwards through the vitreous humour, to reach the posterior surface of the capsule of the crystalline lens. Central; of retina. Branch to capsule of lens.

The *supra-orbital* branch, *d*, ascends above the muscles, and in its course forwards to the supra-orbital notch, accompanied by the frontal nerve, lies immediately beneath the roof of the orbit. The artery mounts towards the forehead, and distributes several branches to the parts around, besides some which are distributed upon the eyelids: it communicates with the temporal artery. Supra-orbital.

The *ciliary* arteries are divisible into three sets: viz. short, long, and anterior ciliary. The *short* ciliary arteries vary from twelve to fifteen in number, and enclose the optic nerve as they pass forwards to reach the posterior aspect of the sclerotic coat, which they pierce, in order to enter the eyeball, about a line or two from the entrance of the optic nerve. The *long* ciliary arteries, two in number, also enter the back of the eye, and then pass forwards, one on each side of the middle of the eyeball, between the choroid membrane and the sclerotic, as far as the ciliary ligament, where they divide into branches. The *anterior* ciliary arteries are derived from some of the muscular branches; they form a vascular circle around the fore part of the eyeball, and then pierce the sclerotic within a line or two of the margin of the cornea. All these ciliary arteries anastomose together within the eyeball, where their distribution will be particularly described with the anatomy of the eye itself. Ciliary; short, long, anterior.

The *muscular* branches are subject to much variety in their course and distribution, like all vessels to muscles: they supply the muscles of the orbit. Muscular.

The *ethmoidal* branches are two in number, a *posterior*, Ethmoidal

posterior; and an *anterior*. The former passes through the posterior ethmoidal foramen in the inner wall of the orbit; having given some small branches to the posterior ethmoidal cells, it enters the skull, and, after supplying the adjacent dura mater, sends minute vessels through the foramina of the cribriform plate of the ethmoid bone to the nasal fossa.

anterior. The other, or *anterior* ethmoidal artery, passes with the nasal branch of the ophthalmic nerve through the anterior foramen; furnishing offsets to the anterior ethmoidal cells and the frontal sinuses, it reaches the interior of the skull, and, like the preceding vessel, supplies the dura mater, and sends branches through the cribriform lamella to the nose.

Palpebral. The two *palpebral* branches, *superior* and *inferior*, arise usually in common, but soon diverge as they pass forwards, one lying above, the other below the tendon of the orbicularis muscle at the inner angle of the eye: they form arches, one in each lid, and branches are sent to the caruncula lachrymalis and the lachrymal sac.

Nasal. The *nasal* branch courses forwards above the tendon of the orbicularis muscle to the root of the nose, where it ramifies, maintaining a free communication with the nasal and the angular branches of the facial artery.

Frontal. The *frontal* branch runs close to the preceding, but on reaching the margin of the orbit turns upwards on the forehead, where it anastomoses with the supra-orbital artery.

CEREBRAL ARTERIES.

Cerebral branches of internal carotid. The terminal branches of the internal carotid artery, which are given off after it has pierced the layer of the dura mater forming the wall of the cavernous sinus, supply the pia mater and the brain [plate 87, fig. 2].

Anterior cerebral; The *anterior cerebral* (anterior cerebri sive corporis callosi), *f*, commences at the subdivision of the internal carotid at the inner end of the fissure of Sylvius. From this point it turns forwards towards the middle line to reach the longitudinal fissure between the anterior lobes of the cerebral hemispheres, across which fissure it is connected with the corresponding vessel of the opposite side by a branch, *g*, not more than two lines in length, named the *anterior*

and communicating. *communicating*. The two anterior cerebral arteries, lying close together, in the next place turn round the anterior border of the corpus callosum, run from before backwards

upon its upper surface, overlapped by the cerebral hemispheres, and end by anastomosing with the posterior cerebral arteries in the back part of the fissure. In this course numerous branches are given off by each artery to the hemisphere of the brain, and to the anterior perforated space.

The *middle cerebral* artery, *h*, the largest branch of the internal carotid, inclines obliquely outwards, taking the course of the fissure of Sylvius; within this it divides into several branches, which supply the pia mater investing the surfaces of the anterior and middle lobes of the brain, and join with the branches of both the anterior and posterior cerebral arteries. Some of its branches, without ramifying in the pia mater, turn forwards to and enter the brain at the anterior perforated spot, through which they reach the corpus striatum. **Middle cerebral.**

One or two *choroid* arteries, which sometimes arise directly from the internal carotid, enter the fissure between the middle lobe and the crus cerebri, to reach the descending cornu of the lateral ventricle in which they are distributed to the choroid plexus. **Choroid arteries.**

The *posterior communicating*, fig. 142, *e*, runs directly backwards, parallel with the corresponding artery of the opposite side, so that they enclose between them the infundibulum and the corpora albicantia; they terminate in the posterior cerebral arteries, and thus form the sides of the circle of Willis. **Posterior communicating.**

Circle of Willis.—A remarkable anastomosis exists between the branches of the vertebral and internal carotid arteries within the cranium, by which the circulation in the brain may be equalised, and any irregularity which might arise from the obliteration of one, or even two of the vessels, may speedily be remedied by a corresponding enlargement of the others. This anastomosis, which is known as the *circle of Willis* [plate 87], results from a series of communications between the following branches. The anterior cerebral arteries are connected together in the longitudinal fissure by the anterior communicating artery. The internal carotids of each side, the trunks from which the anterior cerebral arteries arise, are united to the posterior cerebral arteries by the posterior communicating arteries, and the posterior cerebral arteries themselves arise behind from a single trunk—the basilar artery. Within, or opposite to the area of this vascular circle are the follow- **Carotid and vertebral arteries united in cranium.** **Circle of Willis.**

ing parts of the encephalon, viz.—the commissure of the optic nerves, lamina cinerea, infundibulum and tuber cinereum, corpora albicantia, locus perforatus with part of the crus cerebri, and the origin of the third pair of nerves of each side.

Peculiarities in lachrymal.

Peculiarities.—The *lachrymal* branch of the ophthalmic has been occasionally found, as already referred to, to be supplied by the anterior branches of the middle meningeal artery.

Cerebral arteries.

Anterior communicating.

The deviations from the ordinary condition of the cerebral arteries have reference mostly to the mode in which the circle of Willis is completed. Thus the *anterior communicating* artery, which is usually very short and of good size, may be longer and smaller than usual; and it has been found double either in the whole or in part of its length. Sometimes, but very rarely, this communicating branch is wanting, the two anterior cerebral branches of the internal carotid being then united at once into a single trunk (like the basilar artery behind); which, after a certain course, again divides into the right and left anterior cerebral arteries, or arteries of the corpus callosum (J. F. Meckel).—Another very rare condition of the anterior cerebral artery has been described by Arnold,* in which one large anterior cerebral artery supplied the place of both as to its distribution, and was connected only by slender branches to the internal carotid of the opposite side [plate 87, fig. 5].

Posterior communicating.

The *posterior communicating* artery varies much in size, being sometimes very small; whilst, on the contrary, it is often found so large that the posterior cerebral artery may be said to spring from the internal carotid instead of from the basilar [plate 87, fig. 4]. The posterior communicating artery on one side is very frequently found larger than on the other: and it has occasionally been seen to be represented by two very slender vessels.

An unusual branch of the internal carotid.

The internal carotid was in one instance observed to furnish a remarkable branch which, passing backwards through the basilar portion of the sphenoid bone,† joined with the basilar artery, and formed the anterior part of that vessel.

ARTERIES OF THE UPPER LIMB.

The artery of the upper limb;

The arterial trunk which supplies the upper limb continues undivided from its commencement as far as the bend of the elbow; but successive portions of the same vessel have received different names according to the regions through which they pass. This division, however artificial, serves for facility of reference and description. From the commencement of the vessel as far as the outer border of

* "Bemerkungen über den Bau des Rückenmarks," &c. Taf. 2. Zurich, 1838.

† The preparation is in the Macartney collection in the Anatomical Museum at Cambridge. Drawings obligingly furnished by Professor Clark, will be found in the "Arteries," &c. [plate 87, fig. 6, 7].

the first rib it is named *subclavian*, owing to its position beneath the clavicle ; from the first rib to the lower border of the axilla, it is named *axillary ;* and from thence along the arm to the bend of the elbow, *brachial*, with which the single trunk ends. This mode of division is similar to that of the artery of the lower limb into iliac, femoral, and popliteal. At the bend of the elbow the brachial ends in the radial and ulnar arteries—the subdivision of the vessel into two parts coinciding with the occurrence of two bones in the skeleton of the limb. how sub-divided.

SUBCLAVIAN ARTERIES.

In most parts of the body the description of the artery of one side serves likewise for that of the other, but this is not the case as regards the vessels now under consideration ; for, as the right subclavian artery commences at the division of the innominate trunk, whilst the left subclavian arises at once from the arch of the aorta, it follows that the two vessels must differ materially at first in their length, direction, and connections with contiguous parts. The two subclavian arteries, differ in length, direction, and relations.

In the description of these important vessels, each subclavian artery is conveniently divided into three parts,—the *first* part extending from the origin of the vessel to the inner border of the anterior scalenus muscle ; the *second* consisting of the portion of the vessel situate beneath that muscle ; and the *third* reaching from the outer border of the same muscle to the end of the artery, opposite to the outer border of the first rib. Each of these portions will be now examined in detail. Only the first part requires a separate description for the right and the left side, for in it alone is there any material difference in the anatomy of the two vessels. Each divided into three parts ; their limits.

The *first* part of the *right subclavian* artery [plate 16], commencing close to the trachea at the division of the innominate behind the upper part of the articulation of the sternum with the clavicle, and ending at the inner margin of the anterior scalenus muscle, arches upwards and outwards away from the carotid artery across the root of the neck, and in doing so ascends above the level of the clavicle, —the extent to which it reaches above that bone varying in different cases. The whole of this portion of the artery is deeply placed, being covered by the platysma, the sterno-mastoid, the sterno-hyoid and sterno-thyroid, with the fascia First part of right subclavian; ascends above clavicle ; is deeply placed ;

separating those muscles [plate 17, fig. 1]. Behind the commencement of the artery but separated by a considerable interval from it, is the lateral part of the spine covered by the longus colli muscle; and below it (along the concavity of the curve), and likewise somewhat behind it, is the pleura, which is in contact with the vessel till it rests on the first rib.

connections with veins; *Veins.*—The subclavian vein is lower than the first part of the right subclavian artery, close under the clavicle. In its course to join this vein, the internal jugular crosses in front of the artery near the scalenus muscle [plate 16]; and a vertebral vein lying along the inner side of the jugular has the same position with reference to the artery. The anterior jugular vein running outwards from the fore part of the neck beneath the sterno-mastoid muscle, will likewise cross the course of the subclavian artery.

with nerves. *Nerves.*—The vagus nerve crosses in front of the artery, and on the inner side of the internal jugular vein, as would be expected from the relative position maintained by the vein and nerve along the neck: the recurrent laryngeal branch of this nerve turns upwards behind the artery, hooking, as it were, under the vessel between it and the pleura. Behind the vessel and on the side of the vertebral column, but not in contact with it, lies the chain of the sympathetic nerve; and some branches cross before the artery [plate 17, fig. 1].

First part of left subclavian differs from right in origin; The *first part* of the *left subclavian* differs from the right subclavian in origin, and, as a consequence of this, differs likewise in length, direction, and connections. It arises from the end of the transverse part of the arch of the aorta, and ascends to the margin of the first rib, behind the insertion of the anterior scalenus muscle to that bone. It is therefore longer than the first part of the right subclavian, and ascends almost vertically out of the chest, instead of arching, like that vessel, outwards across the neck. Commencing then from the deepest part of the aortic arch, the left subclavian is at first overlapped by the left lung, and is covered in front and on the left side by the pleura; it is placed before the vertebral column (on which is laid the longus colli muscle), and lies, for a short space, in front of the œsophagus (here deviating to the left side) and the thoracic duct. To the inner or right side of the vessel are situate the left carotid, the trachea, and the œsophagus and thoracic duct.

is longer; ascends vertically; its connections;

Nerves.—The pneumo-gastric nerve is anterior to the left subclavian, and parallel with it, the recurrent branch on this side turning round the aorta. The phrenic nerve descends over the artery along the inner margin of the scalenus muscle, immediately outside the thyroid axis.* The cardiac nerves of the left side descending from the neck, are close to the artery. with nerves

Veins.—The internal jugular vein is immediately before the artery, where it turns outwards from the thorax—close to the scalenus muscle; and the left innominate vein is likewise anterior to it. with veins.

For the second and third divisions of both subclavian arteries, one description will suffice.

The *second* subdivision of the subclavian artery, being only that portion which is concealed by the anterior scalenus muscle, is necessarily very short. It forms the highest part of the arch described by the vessel, and is therefore the most distant from the clavicle. Somewhat less deeply placed than the first part, this portion of the vessel is covered by the platysma, and the sterno-mastoid, with layers of the cervical fascia. Behind, it rests against the middle scalenus muscle; and below, it lies on the pleura. Second portion of the subclavian; forms summit of the arch of the vessel.

Veins and Nerves.—The subclavian vein is lower than the artery [plate 16], and the anterior scalenus muscle lies between the two vessels. The phrenic nerve, which descends obliquely inwards, is likewise separated from this part of the artery by the same muscle; and beneath the scalenus, immediately above the artery, are the large cervical nerves which form the brachial plexus. Connections with veins and nerves.

The *third* portion of the subclavian artery extends outwards and downwards from the border of the anterior scalenus to the upper surface of the first rib as far as the outer margin, where the vessel assumes the name axillary. In this part of its course, the artery lies in a small triangular space, the sides of which are formed by the omo-hyoid and clavicle, and the base by the anterior scalenus muscle: the omo-hyoid is in some instances immediately over the artery. The subclavian is nearer to the surface here than elsewhere, being covered only by the platysma, and layers of the cervical fascia (besides the common integuments); but towards Third portion of the subclavian in triangular space; is nearer the surface than other parts of artery;

* In two cases the phrenic nerve was seen to cross the third part of the artery on the outer side of the scalenus muscle; but in both instances the thyroid axis arose beyond the scalenus, and the nerve was as usual on its outer side [plate 21, fig. 7].

its termination the artery becomes deeper, sinking under the clavicle and the subclavius muscle.

its connections with veins; The subclavian vein is anterior to, and lower than the artery. This vein is lower than the artery in its whole course, being close behind the clavicle, while the artery arches above that bone. The external jugular vein lies over the artery, and it receives on the outer side from the shoulder the two veins which accompany the supra-scapular and transverse cervical arteries [plate 17, fig. 1]. The veins in some cases form a sort of plexus over the artery.

with nerves. *Nerves.*—Above the vessel, and to its outer side, are placed the large brachial nerves, the lowest cord formed by the union of the last cervical and the first dorsal nerve being in contact with it. It may be added, that the space which lodges the artery is crossed in front by the superficial descending (clavicular) branches from the cervical plexus; and that the little nerve of the subclavius muscle is directed over the artery.

Peculiarities *Peculiarities.*—Most of the variations of the two subclavian arteries from their ordinary condition require to be separately noticed.

of right subclavian; The *right subclavian.*—The *origin* of this artery, necessarily varying with the place of bifurcation of the innominate artery, in some cases commences within the thorax [plate 20, fig. 2], instead of at the ordinary situation (the upper margin of the sterno-clavicular joint), and in a smaller number of instances it arises in the neck, at some distance above the level of the clavicle [plate 20, fig. 3].

sometimes arises from aorta; The right subclavian artery sometimes springs as a separate vessel from the aorta. And in such cases, it may be the first of the branches from the aortic arch, or, but more rarely, the second or third in order, or, as is most frequently the case, it may be the last of those branches [plate 6, fig. 10 et seq.]. The course taken by the artery in each of these cases, and its position with regard to other parts, require notice. When the right subclavian is the first branch from the arch, it occupies the ordinary position of the innominate artery. In those very rare cases in which this vessel was the second or third of the aortic branches, it gained its usual position after crossing behind the right carotid. Lastly, when the right subclavian is the last branch given off from the arch of the aorta, it springs from the upper, or from the back part of the arch [plate 20, fig. 5], or it may arise (but this is very rarely met with) much lower down from the descending portion of the aorta [plate 23, fig. 6].

passes behind œsophagus. In any case of late origin of the subclavian, its *usual course* towards the right side of the neck is to cross obliquely in front of the vertebral column, and behind the œsophagus. There would seem to be but one accurately recorded case in which this artery, arising from the last part of the aortic arch, passed between the œsophagus and the trachea [op. cit. p. 154, and plate 20, fig. 7].

Peculiarities of left subclavian; The *left* subclavian very seldom arises in common with another vessel: it has, however, been found in a few cases conjoined with the

left carotid [plate 7, figs. 4 and 5]. When the aorta arches to the right side, the innominate, if present, exists on the left side, and the left subclavian springs from it. Independently of such cases, the junction between the left subclavian and left carotid is of extremely rare occurrence. One of the very few examples which have been observed is represented in [plate 6, fig. 9]. seldom joined with another vessel;

It is an interesting fact that, although in cases of transposition of the aorta the left subclavian artery generally arises, as is usual on the right side, from an innominate trunk, it has also been observed to assume another arrangement occasionally presented as an unusual condition by the artery of the right side, viz. being the last of the branches derived from the arch of the aorta. In this case it crosses obliquely over the front of the vertebral column towards the left side of the neck.

The left subclavian artery has been observed in the fœtus to arise from the ductus arteriosus [plate 20, figs. 10, 11]; and in the adult from a conical dilatation or pouch connected with the cord formed by the obliterated portion of the "arterial canal." This pouch, which has been met with also in connection with the origin of the right subclavian when that vessel is detached from the innominate, appears to be formed by a part of the canalis arteriosus, which continues pervious in consequence of the subclavian artery arising from it. A similar pouch, but of much smaller size, is sometimes seen at the attachment of the ductus arteriosus to the aorta, without having any branch connected with it. [See op. cit. p. 157, and plate 6.] arises from ductus arteriosus; from a pouch.

Peculiarities affecting both subclavian arteries.—The height to which these vessels may reach in the neck is liable to variation to some extent. Most commonly the artery crosses the neck a little higher than the clavicle, but it is sometimes placed as high as an inch or even an inch and a half above the level of that bone. The greater extent of elevation above the clavicle, however, is especially seen in the artery of the right side [plate 2, figs. 2 and 3]. Now and then the subclavian artery perforates the anterior scalenus muscle [plate 21, figs. 1, 2], and in a few rare cases it was altogether in front of the muscle [fig. 3], and was at the same time close to the subclavian vein. That vein has been also seen to pass with the artery behind the scalenus muscle. Height of subclavian artery in neck; passes through or before scalenus muscle.

BRANCHES OF THE SUBCLAVIAN ARTERIES, CONSIDERED WITH REFERENCE TO THE TRUNK.

The branches of the subclavian artery are so large and numerous in proportion to the length of the vessel from which they spring, that their number, and the place of their origin, are important considerations in the anatomical history of the artery itself, in consequence of the influence their position would have in determining the point best suited for the application of a ligature in a surgical operation. Branches;

Four branches usually arise from each subclavian artery. Of these, three generally spring together from the first subdivision of the artery, namely, the vertebral, the internal mammary, and the thyroid axis; and one from the second division, viz. the superior intercostal, to which may be added usually are four in number; three from first part;

one from second part of artery.

a small spinal branch. On the left side, the second portion has usually no branch, the superior intercostal arising most frequently to the inner side of the scalenus muscle. The third part of the artery gives rise to no offset,—at least, this is the case in a majority of instances.

Their position on first part of artery; left side.

As the first part of the left subclavian artery does not admit of being tied in a surgical operation, the position of its branches has little interest in a practical point of view. It will be enough to say that the branches generally arise close together at the inner side of the anterior scalenus muscle.

Right side;

On the right side also, the branches occupy usually the same position in regard to the scalenus muscle; and in consequence of this part being accessible in an operation for aneurism, it is desirable to determine the ordinary distance between the commencement of the artery and the nearest branches.

free interval.

In a majority of many observations the interval measured from half an inch to an inch; in a smaller number, more than one inch, and not exceeding an inch and a half. The space seldom varied from these limits; but in a few instances it was found to be less than half an inch, and it amounted, in only one body, to an inch and three-quarters.

But as considerable variations are found to occur in the position and number of all the branches, it is necessary to refer more particularly to those given from each part of the artery in different cases, reserving the details respecting each branch for the description which will be given of them individually.

Branches on first part.

Peculiarities.—Instead of the three branches arising close together on the *first part*, one is sometimes shifted inwards from the accustomed position [plate 21, figs. 9, 10]. In a very few cases the branches arise at intervals, being, as it were, dispersed over the first part of the artery [plate 21, fig. 5.] Lastly, one or more of the branches have been (very unfrequently however) moved outwards to another division of the subclavian [plate 21, fig. 6, 7].

Branches on second part.

The *second* portion of the subclavian artery was found in about two-thirds of a large number of cases (upwards of two hundred and sixty) to give origin to only a single branch, which was usually the common trunk of the superior intercostal and deep cervical arteries. In the remaining third of the total number of bodies examined, this part of the subclavian artery was, in most instances, quite destitute of branches, and this occurred more frequently on the left than on the right side. In some few bodies, two and even three branches arose from it [plate 21, fig. 6].

Third part; branches.

As regards the *third* part of the artery: in more than half of upwards of two hundred and sixty bodies, it furnished no branch whatever [plate 3]; in less than half, it gave origin to a single branch, which was usually the posterior scapular artery [plate 16]. A few examples occurred of two, and much more rarely of three branches, arising from this part of the vessel [plate 21, figs. 7, 8, 10].

BRANCHES OF THE SUBCLAVIAN ARTERIES.

The three large branches which arise from the first part of the subclavian artery spring from the parent trunk very close to each other, and are deeply seated at their origin under cover of the internal jugular vein [plates 2 and 16]. They proceed, however, from different sides of the vessel, pursue different directions, and are distributed to remotely separate parts. Thus, one (vertebral) springs from the upper and hinder part of the subclavian, and ascends in the neck to reach the interior of the skull; another (internal mammary) proceeds from the lower or under side of the vessel, and descends into the fore part of the chest and abdomen; whilst the third (thyroid axis) arises from the fore part of the artery, and divides into three branches, one of which (inferior thyroid) is distributed in the fore part of the neck, whilst the other two (suprascapular and transverse cervical) pass outwards across the neck to the shoulder. Lastly, from the second part of the subclavian artery, two other branches arise by a common trunk; of which one (deep cervical) passes upwards behind the neck, and the other (superior intercostal) descends into the upper part of the thorax.

Branches pass in different directions;

their course generally stated.

VERTEBRAL ARTERY.

The vertebral artery, which is usually the first and largest branch of the subclavian, passes upwards through the foramina between the transverse processes of the cervical vertebræ, and after a winding course enters the skull through the foramen magnum, and terminates in front of the medulla oblongata, by uniting with the corresponding vessel on the opposite side, to form the basilar artery. The singular course of this vessel thus generally indicated, requires a more precise examination.

Vertebral artery;

outline of course;

Arising from the upper and back part of the subclavian, the vertebral artery passes upwards and a little backwards, and enters the intertransverse foramen of the sixth cervical vertebra—not unfrequently of some higher vertebra. The vessel then ascends in a vertical direction through the series of foramina of the transverse processes of the vertebræ, as far as to the upper border of the axis; here, in consequence of the greater width of the atlas, it inclines outwards to the foramen of that bone. Having passed through this aperture,

enters foramen in sixth vertebra.

Curves between

atlas and axis, and on latter; the artery alters its direction and winds backwards behind the articulating process of the atlas, resting in the shallow groove on the neural arch of that vertebra. After passing enters foramen magnum into skull; beneath the ligament connecting the atlas to the occiput (posterior occipito-atloidean) and piercing the dura mater, it enters the skull through the foramen magnum of the occipital bone; and finally, proceeding upwards and forwards, both arteries unite. turns round the side of the medulla oblongata, and converging towards the corresponding vessel of the opposite side, unites with it opposite the lower border of the pons Varolii, to form the basilar artery.

Connections with parts in neck; As it is directed upwards from its origin towards the spine, the vertebral artery lies behind the internal jugular vein, and on approaching the vertebræ passes between the longus colli and the scalenus anticus muscle. On the left side, the thoracic duct crosses in front of the vessel from within outwards.

Whilst within the foramina of the cervical vertebræ, it is accompanied by a plexus of the sympathetic nerves and by the vertebral vein, which is before it. Here the artery is placed in front of the cervical nerves as they emerge from the intervertebral foramina. The first and second nerves have peculiar positions in relation to this artery, an account of which will be found in the description of those nerves.

In the interval between the atlas and the occipital bone the vertebral artery is covered by the superior oblique in the skull. muscle. Within the skull, it turns round the side of the medulla oblongata between the origin of the hypoglossal nerve and the anterior root of the suboccipital, and then lies between the anterior surface of the medulla and the basilar process of the occipital bone.

Peculiarities *Peculiarities of the vertebral artery.* There is no recorded instance of the origin of this vessel being transferred from the first part of the subclavian artery to the parts situate beneath and beyond the scalenus muscle.

in origin of right vertebral; On the *right* side, the origin of the vertebral artery in some cases approaches more nearly to the commencement of the subclavian than usual [plate 21, fig. 10]. The right vertebral has been also seen to arise from the common carotid of the same side; and in the examples of this peculiarity which have been observed, the right subclavian artery was given as a separate vessel from the aorta [plate 6, fig. 13]. The change in the subclavian artery is however far from being necessarily, or even generally accompanied by an alteration in the place of origin of the vertebral [plate 20, fig. 5]. Lastly, the right vertebral artery has been

...ut only in two instances, to be a branch of the aorta [plate

...t vertebral artery is not unfrequently derived from the aorta ... in which case it generally arises between the left carotid and ... arteries, but sometimes it is the last of the branches from

... vertebral artery in a few instances, and the right vertebral ... has been found to arise by more than a single root. ... examples there were two roots, both of which ... subclavian artery [plate 22, fig. 9], or one from that vessel and ... aorta [fig. 7, 8]. Whatever their mode of origin ... unite to form a single vessel, either before they enter the ... aperture, or after one of the vessels has passed through ... or two vertebræ. An example of ... has been placed on record. [See plate 24, fig. 2.] ... of entering the foramen of the sixth vertebra ... of one side not unfrequently enters higher ... of the fifth, fourth, or third vertebra ... anatomists, of the second. On the other hand ... has been seen to enter the intertransverse foramen ... [plate 22, fig. 5].

... of the vertebral arteries often ... is said to be the larger vessel ... fig. 1].

The *branches* of the vertebral artery ... small ones are given off in the neck ... within the skull.

a. Cervical branches.—In the neck ... off at different points of ... branches named *spinal* arteries. ... canal through an intervertebral foramen ... branches; one of these ... spinal nerves, supplying the ... and anastomoses with the other ... other branch ramifies on the ... vertebræ in the same manner as ... from the intercostal and lumbar ... after described [plate 27, fig. ...].

The vertebral artery ... variable size to the deep-seated ...

b. Cranial branches.—The ... branch which arises opposite ... ramifies between the ... occipital fossæ, and ... sometimes two of these small ...

The *posterior spinal* ... at an obtuse angle from ... round the medulla oblongata ...

consists of several small branches.

spinal cord; aided by reinforcements from small arteries which ascend upon the cervical and dorsal nerves through the intervertebral foramina, it may be traced along the cord, lying behind the roots of the nerves, as a minute tortuous vessel, or rather a series of little inosculating vessels, as far as the second lumbar vertebra, where it terminates in ramifications on the cauda equina. Some of its branches run upon the cord around the roots of the nerves, whilst others maintain frequent transverse communications with similar branches from the vessel of the opposite side.

Anterior spinal artery;

The *anterior spinal artery*, *n*, [plate 87, fig. 2,] somewhat larger than the preceding, arises near the end of the vertebral artery, and descends obliquely in front of the medulla oblongata. Immediately below the foramen magnum, it unites with the corresponding vessel of the opposite side, so as to form a single trunk, which descends a short distance only along the middle line in front of the spinal cord, forming the upper part or commencement of the anterior median artery of the cord. This anterior spinal branch of the vertebral artery supplies therefore only the upper part of the cord; the remainder being provided with a series of small arteries, which are derived in the neck from the vertebral and inferior thyroid arteries, in the back from the intercostal, and below this from the lumbar, ilio-lumbar, and lateral sacral arteries. These small vessels enter the spinal canal at irregular intervals through the intervertebral foramina, and passing along the roots of the nerves, communicate with each other along the middle line by means of ascending and descending branches; so that, by a succession of anastomoses, a very slender single vessel, but of varying thickness, named the *anterior median artery* appears to extend from the one end to the other of the cord. This vessel, or chain of inosculating vessels, supplies the pia mater and the substance of the cord—some entering the anterior median fissure. At the lower end of the spinal cord it sends branches downwards on the cauda equina.

itself very short;

several branches join it.

On a part of the spinal cord near the lower end, and in front of the posterior roots of the nerves, may be found another small artery, about equal in size to the anterior spinal.

Inferior cerebellar.

The *inferior cerebellar artery* (profunda cerebelli,—Haller), the largest of the branches of the vertebral, arises near the pons, and sometimes from the basilar artery: it turns backwards and outwards, between the hypo-glossal and pneumo-

gastric nerves, over the restiform body and near the side of the opening of the fourth ventricle, to reach the under surface of the cerebellum. Here, running backwards between the inferior vermiform process and the hemisphere, it divides into two branches: one of which continues backwards in the sulcus between the hemispheres; whilst the other, turning outwards, ramifies on the under surface of the cerebellum as far as its outer border, over which the ultimate divisions of each branch anastomose with those of the superior cerebellar arteries. This artery partly supplies the hemisphere and the vermiform process, and gives branches to the choroid plexus of the fourth ventricle.

Basilar artery corresponds with pons Varolii.

The *basilar artery*, fig. 142, *k*, [plate 87, fig. 2,] is the single trunk, formed by the junction of the right and left vertebrals in the middle line, and is so named from its lying on the basilar process of the occipital bone. It extends from the posterior to the anterior border of the pons Varolii, along the median groove of which it lies, under cover of the arachnoid. The length of this artery is therefore about equal to that of the pons, at the anterior border of which it divides into two terminal branches, the posterior arteries of the cerebrum.

Branches to auditory meatus;

Branches of the basilar artery.—The basilar artery supplies many small branches to the substance of the pons. On each side it also gives several transverse branches; one of these accompanies the acoustic nerve into the internal auditory meatus and labyrinth of the ear; and another of more considerable size, the *anterior cerebellar* artery (cerebelli inferior anterior), passes backwards along the fore part of the crus cerebelli to the anterior part of the under surface of the cerebellum.

inferior cerebellar.

Superior cerebellar.

The *superior cerebellar artery*, fig. 142.—The superior arteries of the cerebellum arise so close to the bifurcation of the basilar, that this artery is described by several anatomists as dividing into four branches. Each one turns backwards and outwards immediately behind the third nerve, and entering the groove between the pons Varolii and the crus cerebri, turns round the latter, close to the fourth nerve, to reach the upper surface of the cerebellum, where it divides into branches. Of these some extend outwards, and one or more backwards along the superior vermiform process, to reach the circumference of the cerebellum, where they anastomose with the branches of the inferior cerebellar arteries: other branches run inwards to supply the vermiform process

and the valve of Vieussens, and in part the velum interpositum—an extension of the pia mater into the interior of the brain.

Posterior cerebral.

The *posterior cerebral artery*, *p* (posterior aut profunda cerebri,—Haller), is larger than the preceding vessel, and is separated from it at the origin by the third nerve, which comes forwards between the two vessels. It turns backwards round the crus cerebri, at first parallel with the last-named vessel, and then runs outwards and upwards on the under surface of the posterior lobe of the cerebrum, passing near the posterior extremity of the corpus callosum. It divides beneath the posterior lobe into many branches, which ramify upon the under, inner or median, and outer surfaces, and anastomose with the other cerebral arteries. Immediately after its origin the posterior cerebral artery gives off numerous small parallel branches, which perforate the substance of the brain between the crura, at the point which is called from this circumstance the posterior perforated spot (locus perforatus). As it turns backwards, a short distance from its origin, this artery is joined by the *posterior communicating artery*, or communicating artery of Willis, a branch of the internal carotid, and in this way contributes as already described (p. 259) to form the circle of Willis. Lastly, the posterior cerebral gives origin to a small branch, the *posterior choroid* (choroidea posterior), which arises soon after its junction with the communicating artery, turns backwards over the crus cerebri and the tubercula quadrigemina, supplying these with branches, and ending in the velum interpositum and choroid plexus in the interior of the brain.

Posterior communicating.

Posterior choroid.

Various branches.

Peculiarities of the branches of the vertebral artery.—In the neck, the vertebral artery has been found, though very rarely, to give branches which are usually derived from the subclavian, as the superior intercostal and the inferior thyroid [plate 22, figs. 5, 6].

Basilar.

In two instances, the septum formed by the juxtaposition of the vertebral arteries behind the basilar, has been observed by Dr. Davy* to be perforated by an opening as large as a probe. Not unfrequently the interior of the basilar artery itself is traversed by a fibrous band, which is attached to the sides of the vessel. This band varies in situation and dimensions, and is considered by Dr. Davy to be congenital, and not the result of disease.

In one instance the basilar artery was joined by a large branch of the internal carotid (p 260). Sometimes a small "aberrant" branch is

* "Researches," &c., vol. i. p. 301.

connected with the side of the basilar. Lastly, the basilar artery has been found to be perforated by a small foramen, owing to a partial fissuring of the vessel, along the median line [fig. 8].

The posterior cerebral artery is occasionally given off on one side from the internal carotid artery [plate 87, fig. 4]. Posterior cerebral.

THYROID AXIS.

Thyroid axis (inferior thyroid artery: thyreoidea inferior arteria,—Haller).—The name "axis" is applied to this artery because immediately after its origin it divides into branches, which diverge in different directions, viz. the inferior or ascending thyroid, the transverse cervical, and the suprascapular. The thyroid axis springs from the fore part of the subclavian artery close to the inner side of the anterior scalenus muscle. It is a short thick trunk, and usually divides a line or two from its origin into the branches above named.

Thyroid axis, divides into three branches; origin; is very short.

Peculiarities of the thyroid axis.—Exceptions to the regular place of origin of the thyroid axis at the inner side of the scalenus muscle are very rare. The vessel has, in two cases, been found to arise beyond that muscle.

Peculiarities in origin;

Sometimes the thyroid axis is associated at its origin with another branch. Thus, it gave origin to the internal mammary in about one case in twenty; and only once, in nearly three hundred cases, to the vertebral; once to the superior intercostal; and once to the profunda cervicis.

seldom joined with others.

The deviations from the ordinary arrangement of the branches of the thyroid artery will be examined under each branch.

The *inferior thyroid artery* (ramus thyreoideæ thyreoideus —Haller).—This name is applied by most authorities to the common trunk here recognised as the axis. This artery [plate 16] passes directly upwards resting on the longus colli muscle, and bends inwards and downwards after a short course behind the sheath of the large cervical vessels, and also behind the sympathetic nerve (the middle cervical ganglion of which, when present, often rests upon the vessel). The artery now makes another curve in the opposite direction to the former one, and is distributed to the under surface of the thyroid body. Its branches communicate freely with those of the superior thyroid artery (an offset from the external carotid), and with the corresponding artery of the other side.

Inferior thyroid artery; course and connections; supplies thyroid body.

The inferior thyroid artery supplies usually a *laryngeal* branch of irregular size, which ascends on the trachea to

Small branches.

the back of the larynx, and is distributed to the muscles and mucous membrane in that situation. It gives off *tracheal* branches which ramify over the trachea, upon which they anastomose below with the bronchial arteries. Other small branches are furnished to the œsophagus, and one or more descend upon the trachea into the chest.

Ascending cervical artery;

The *ascending cervical* branch (ramus thyreoideæ adscendens,—Haller).—A small branch thus named arises at the point where the inferior thyroid, changing its direction, turns inwards behind the carotid artery; it proceeds upwards, close to the phrenic nerve, on the line of separation between the scalenus anticus and rectus anticus major, giving *muscular* branches to both, and a few which pass transversely outwards across the neck. These muscular branches communicate with others sent outwards from the vertebral artery. To the spinal canal the ascending cervical artery sends one or two branches (*spinal branches*), which enter the intervertebral foramina along the cervical nerves, and assist in supplying the bodies of the vertebræ, and the spinal cord and the membranes [plate 87].

supplies muscles and spinal canal.

Peculiarities of inferior thyroid in origin,

Peculiarities.—The *inferior thyroid* artery occasionally arises as an independent branch from the subclavian artery [plate 21], and rarely from the common carotid [plate 12, fig. 4] or the vertebral [plate 22, fig. 6].

size,

This artery is often smaller than usual, or it may be entirely wanting, on one or both sides,—the deficiencies being generally compensated for by an enlargement of one or both superior thyroid arteries [plate 23, fig. 3]. On the contrary, one or both inferior thyroid arteries are sometimes larger than usual when the superior arteries are small [fig. 2]. Instances have occurred—very rarely, however,—of the presence of two inferior thyroid arteries, one passing over the common carotid artery [plate 23, fig. 11].

number.

In this place may be noticed, in connection with the peculiarities of the inferior thyroid arteries, that there is sometimes an additional artery for the thyroid body, which has been named the *lowest thyroid* artery (thyroidea ima, of Neubauer and Erdmann). This artery usually arises from the innominate trunk, [plate 23, figs. 7, 8, 9,] but in rare instances it has been observed to come from the right common carotid artery [fig. 10], or from the aorta itself [plate 7, fig. 9]. It is of very different size, in different bodies, and compensates in various degrees for deficiencies or absence of the other thyroid arteries [plate 23, figs. 7, 8, 9]. This unusual thyroid artery ascends to its destination in front of the trachea, and its existence might therefore complicate the operation of tracheotomy.

Thyroidea ima of Neubauer;

takes place of other arteries.

Ascending cervical branch;

The *ascending cervical artery* is occasionally derived from the subclavian [plate 21, fig. 5] or from one of the branches of that vessel, as from the transverse cervical, or the suprascapular, or from the trunk common to those two arteries.

It is sometimes much larger than usual, and takes the place of the

occipital artery,—a branch of the external carotid [plate 24, fig. 3]. A branch of the ascending cervical not unfrequently compensates for a small profunda cervicis artery [plate 25, fig. 3]. becomes occipital.

The *suprascapular artery* (ramus transversus scapularis, —Haller), a smaller vessel than the succeeding branch, the transverse cervical, arises almost constantly from the thyroid axis, and runs from within outwards deeply at the root of the neck [plate 16]. At first it descends obliquely towards the clavicle, resting upon the scalenus anticus, and covered by the sterno-mastoid muscle; then crosses the subclavian artery, and continues transversely outwards behind and parallel with the clavicle and subclavius muscle, and below the posterior belly of the omo-hyoid muscle. At the outer part of the neck, this artery approaches the upper margin of the scapula; and here, under cover of the trapezius muscle, it inclines downwards with the suprascapular nerve towards the notch at the root of the coracoid process in the upper border of the scapula. At this point the nerve usually passes beneath the ligament stretched across the notch, whilst the artery turns over it to enter the supraspinous fossa; where, lying close to the bone, it gives off branches which ramify in the fossa beneath the supraspinatus muscle, and sends a small communicating branch into the subscapular fossa. Supra-scapular; behind clavicle; to scapula with nerve.

Branches.—At the root of the neck, whilst under cover of the sterno-mastoid, the suprascapular artery gives off a small branch which runs inwards through the attachments of that muscle, and supplies it. In its course across the neck, the artery sends small unnamed branches to the adjacent muscles. Branches.

It also gives a *supra-acromial branch*, which passes obliquely forwards through the attachment of the trapezius to reach the cutaneous surface of the acromion, on which it ramifies, anastomosing with offsets from the acromial thoracic artery. Supra-acromial,

As the artery passes over the notch of the scapula, a small branch arises from it, and turns forwards over the neck of the bone to enter the subscapular fossa, where it ramifies beneath the subscapular muscle, and anastomoses with the posterior scapular and subscapular arteries [plate 29, fig. 2]. After having given off this branch, the artery enters the supraspinous fossa and ramifies between the bone and the supraspinatus muscle, to which it is chiefly distributed [plate 19]. to sub-scapular fossa; on dorsum scapulæ.

The suprascapular artery also supplies branches to the bone and to the shoulder-joint; it sends downwards a communi- Infraspinous branch.

cating branch to the infraspinous fossa, which descends close upon the neck of the scapula, between the glenoid cavity and the spine of that bone, and joins with the dorsal branch of the subscapular artery.

Peculi-arities.

Peculiarities.—The suprascapular artery has in some cases been observed to spring directly from the subclavian, or to arise from that vessel by a common trunk with the transverse cervical, or more rarely with the internal mammary [plate 24, fig. 6]. It has been even found to proceed from the axillary artery [fig. 7], and from the subscapular branch of that vessel [plate 25, fig. 1].

Transverse cervical artery;

The *transverse cervical artery*, the third branch of the thyroid axis, passes outwards a short distance above the clavicle, and therefore higher than the suprascapular artery. It crosses over the scaleni muscles, and the brachial plexus, — sometimes passing between the nerves of the latter. Beneath the anterior margin of the trapezius, and near the outer edge of the levator anguli scapulæ, it divides into two branches, the superficial cervical and the posterior scapular.

division into two.

The transverse cervical artery lies deeply in its entire course; being covered by the sterno-mastoid, the omo-hyoid, and the trapezius muscles, besides the platysma and the fascia.

Its terminal *branches* are the two following :—

Superficial cervical.

The *superficial cervical* (superficialis cervicis) ascends beneath the anterior border of the trapezius, and distributes branches to the trapezius, levator anguli scapulæ, and sterno-mastoid muscles, as well as to the cervical glands and the integuments in the interval between those muscles.

Posterior scapular.

The descending or *posterior scapular* branch, fig. 144, *b*, which may be considered the continuation of the transverse cervical, passes backwards to the upper angle of the scapula under cover of the levator anguli scapulæ, and then changing its direction, runs downwards beneath the rhomboidei muscles, as far as the inferior angle of that bone. It anastomoses freely on both sides of the scapula with the divisions of the suprascapular and subscapular arteries; and supplies branches to the rhomboidei, serratus magnus, and latissimus dorsi, communicating at the same time with the posterior muscular branches of some of the intercostal arteries [pl. 19, 29].

Frequent variations.

Peculiarities.—The frequent varieties which occur in the arrangement of the transverse cervical artery and its two branches, have occasioned them to be very differently described and named by different anatomists.

The condition above noticed is that most commonly met with—viz., that the transverse cervical artery is the third branch given off by the thyroid axis, and divides near the levator anguli scapulæ into the superficial cervical and the posterior scapular arteries.

In a great number of cases, however, a condition so common as to have been regarded by some as representing the ordinary one, the *superficial cervical* portion of the artery is derived from the thyroid axis, whilst the *posterior scapular* arises as a separate vessel from the subclavian artery, most commonly beyond the scalenus muscle [plate 1, and 16]. Cervical and posterior scapular separate.

In a third class of cases not nearly so common, the vessel derived from the thyroid axis is very small, and represents only in part the superficial cervical artery; whilst a large vessel arising from the third part of the subclavian divides near the levator anguli scapulæ into two branches, of which one ascends and represents the remaining and larger portion of the superficial cervical artery, whilst the other forms the posterior scapular [plates 3, 19].

The transverse cervical artery is sometimes derived directly from the subclavian, or it arises from that vessel in common with the suprascapular, or occasionally with that and the internal mammary artery also. When this artery arises separately from the subclavian, its place of origin may be beneath or even beyond that muscle. The transverse cervical sometimes gives off the ascending cervical artery. Peculiarities in origin;

When the *superficial cervical* is separated from the posterior scapular, it sometimes arises from other sources than the thyroid axis, as from the suprascapular, or the subclavian. Peculiarities of superficial cervical;

The *posterior scapular* was observed, when it was derived from the subclavian as a separate branch, (a very common arrangement,) to take its origin beyond the scalenus in more than two-thirds of a considerable number of cases, and beneath that muscle in less than one-third; in one case only did it arise to the inner side of the muscle. of posterior scapular.

INTERNAL MAMMARY ARTERY.

The internal mammary artery, remarkable for its length and the number of its branches, arises from the under side of the subclavian, opposite the thyroid axis. It runs forwards and downwards behind the clavicle to the inner surface of the cartilage of the first rib, lying between this and the sac of the pleura; from this point it inclines a little inwards, and then descends vertically behind the costal cartilages, a short distance from the border of the sternum, as far as to the interval between the sixth and seventh cartilages, where the internal mammary artery is considered to end by dividing into two branches. One of the branches into which the artery divides (musculo-phrenic) inclines outwards along the margin of the thorax; whilst the other, under the name superior epigastric, continues onwards to the abdomen in the original direction of the trunk. Internal mammary; behind cartilages of ribs; two terminal branches.

Covered at its origin by the internal jugular vein, like Connections;

the other large branches of the subclavian artery, the internal mammary soon passes behind the subclavian vein, and is crossed in front by the phrenic nerve which lies between the vein and the artery.* In the chest it has at first the costal cartilages and the internal intercostal muscles before, and the pleura behind; but lower down it lies between the cartilages and the triangularis sterni muscle—the muscle separating the vessel from the pleura. This artery has two companion veins, which are united into a single venous trunk at the upper part of the chest.

veins.

Branches.

Branches.—The branches of this long artery are numerous, and are distributed chiefly to the walls of the chest and abdomen.

Comes nervi phrenici.

The *superior phrenic* or *comes nervi phrenici*, a very slender branch, arises high in the chest, and descends with the phrenic nerve (as its name implies), between the pleura and the pericardium, to the diaphragm, in which it is distributed, anastomosing with the other phrenic offsets derived from the musculo-phrenic branch of the internal mammary artery, and with the inferior phrenic arteries which come from the abdominal aorta.

Thymic branches; pericardiac; sternal.

The *mediastinal* or *thymic* branches, of very small size, ramify in the loose connective tissue in the mediastinal space, and supply the remains of the thymus body, which, when in full development, receives its principal branches from the internal mammary artery. *Pericardiac* branches are given off directly to the upper part of the pericardium, the lower part of which receives some from the musculo-phrenic division. Branches, named *sternal*, are also supplied to the triangularis sterni muscle and to both surfaces of the sternum.

Anterior intercostal, two in each space; inosculate with aortic intercostal.

The *anterior intercostal arteries*, two in each space, arise from the internal mammary either separately, or by a trunk common to the two which soon divides. The arteries pass outwards, at first between the pleura and the internal intercostal muscles, and afterwards between the two layers of intercostals; they lie one near the upper, and one near the lower rib in each of the upper five or six intercostal spaces, and inosculate with the corresponding intercostal branches derived from the aortic intercostals. These branches supply the intercostal and pectoral muscles, and give some offsets to the mamma and integument.

* The nerve has been observed in front of the vein [plate 25, fig. 6].

The *anterior* or *perforating* branches pass forwards from the internal mammary artery through from four to six intercostal spaces, and turning outwards ramify partly in the pectoralis major, and partly in the integument on the front of the chest. Some of these perforating branches supply the mammary gland (those placed nearest to the organ), and in the female they are of comparatively large size, especially during lactation; and some offsets ramify on the sternum, and on the articulations of that bone with the cartilages of the ribs. **Perforating branches.**

The *musculo-phrenic* artery, the outer of the two branches into which the internal mammary artery divides, inclines downwards and outwards behind the cartilages of the false ribs, perforating the attachment of the diaphragm at the eighth or ninth rib, and becoming gradually reduced in size as it reaches the last intercostal space. It gives branches backwards into the diaphragm; others, which pass outwards to form the anterior intercostals of each space, and are disposed precisely like those which are derived higher up from the internal mammary itself; and some which descend into the abdominal muscles. Each of these sets of branches anastomoses with those derived from other sources and distributed to the same parts. **Musculo-phrenic; anterior intercostals.**

The *superior epigastric* artery, the abdominal part of the internal mammary, continues in the direction of that artery, and descends behind the seventh costal cartilage to gain the wall of the abdomen, in which it lies behind the rectus, between the muscle and its sheath. From this artery branches are furnished to the upper part of the rectus, which anastomose with the ascending ramifications of the epigastric artery, a branch of the external iliac. Small vessels are likewise supplied to the broad muscles of the belly, and to the skin; some are distributed to the diaphragm, and one runs forwards upon the side and front of the xiphoid cartilage, where it anastomoses with that of the opposite side. **Abdominal branch; inosculates with epigastric artery.**

Peculiarities.—The internal mammary is occasionally found connected at its origin with the thyroid axis, or with the scapular arteries —these being detached from the thyroid. It occasionally springs from the second or third part of the subclavian artery (the latter being the more frequent position of the two) [plate 21, figs. 6, 7]. The internal mammary is very rarely transferred away from the subclavian to another artery. The axillary [plate 24, fig. 4], the innominate,* and **Peculiarities in origin.**

* Erdmann, loc. citat., p. 37.

the aorta [plate 7, fig. 12], have been found to give origin to it. Only a single example has been recorded of each of the last two changes.

Unusual branches. *Unusual branches.*—The internal mammary artery occasionally gives origin to the suprascapular [plate 24, fig. 6]; or furnishes a bronchial artery [fig. 5]. An unusual branch has also been observed descending vertically from the artery at the side of the thorax, and crossing the middle of a few of the ribs, on their inner surface, in contact with the pleura.

SUPERIOR INTERCOSTAL AND DEEP CERVICAL ARTERIES.

Superior intercostal gives profunda cervicis; The superior intercostal artery generally arises from the upper and back part of the subclavian, under the anterior scalenus muscle on the right side, and immediately at the inner side of the muscle on the left side. Taking its course backwards, it speedily gives off the deep cervical branch (profunda cervicis), and bends backwards and downwards in front of the neck of the first or first two ribs, and ends in the first or second intercostal space. On the neck of the first rib, the artery is situate on the outer side of the first dorsal ganglion of the sympathetic nerve.

descends to one or two spaces.

Branches supply intercostal muscles; In the first intercostal space the superior intercostal artery gives an intercostal branch similar in course and distribution to the aortic intercostals; in the second space, this branch usually joins with one from the first aortic intercostal. The intercostal vessel sends backwards a small offset to the posterior spinal muscles, and also a small one through the corresponding intervertebral foramen to the spinal cord and its membranes.

and some to spinal muscles and canal.

Place of origin various; *Peculiarities.*—The place of origin of the superior intercostal artery is occasionally moved to the inner side of the scalenus anticus on the right side. At the left side it has that position in a majority of cases; but is never, as far as our observation extends, moved in the opposite direction—to the outer side of the muscle. It has been found, very rarely however, to proceed from the vertebral artery, or from the thyroid axis. In a few instances the intercostal artery was observed to pass between the necks of one or two ribs and the corresponding transverse processes of the dorsal vertebra; and in one case, after arising from the vertebral artery, it descended through the intertransverse foramen of the last cervical vertebra, and then continued, as in the cases just mentioned, between the necks of the ribs and the contiguous transverse processes of the vertebræ of the back [plate 22, fig. 5]. The intercostal artery is sometimes, though very rarely, wanting.

unusual course.

Arises with superior intercostal; The *deep cervical* branch (profunda cervicis) [plate 18, fig. 1], often described as a separate branch of the subclavian, arises in most cases (13 out of 14) from the superior inter-

costal. Resembling the posterior branch of an aortic intercostal artery, it generally passes backwards in the interval between the transverse process of the last cervical vertebra and the first rib, to reach the posterior aspect of the neck. Here it ascends in the interval between the transverse and spinous processes, as high as the second vertebra, under cover of the complexus muscle, between this and the semispinalis colli: to these and other contiguous muscles it furnishes ramifications. Some of the branches communicate with those given outwards by the vertebral artery, whilst others ascend to anastomose with the cervical branch (princeps cervicis) of the occipital artery. anastomoses with vertebral and occipital arteries.

Peculiarities.—The deep cervical artery occasionally takes its course backwards between the last two cervical vertebræ. In several instances among a large number in which the condition of this artery was noted, it was observed to arise from the intercostal within the thorax, and to proceed backwards below the first rib and the transverse process supporting this; and even, but with much less frequency, below the second rib and its transverse process [plate 25, fig. 2]. It has likewise been seen between the rib and transverse process in passing backwards. Peculiarities; course;

The place of *origin* is occasionally changed. In one case in twenty the deep cervical arose from the subclavian, either beneath the anterior scalenus muscle or at the inner side; and, in a small number of cases, the posterior scapular artery was the source from which it was derived. origin;

The deep artery of the neck is not unfrequently small, the deficiency being compensated for by an additional branch. In most cases this supplementary artery was observed to take origin from the ascending cervical (a branch of the inferior thyroid), which turned backwards beneath the transverse process of the third cervical vertebra, and supplied the defect at the upper part of the neck [plate 25, fig. 3]. This additional artery has likewise been seen to arise from the superior intercostal (as well as the ordinary profunda); and more rarely from the posterior scapular, or the inferior thyroid. size. A second profunda artery.

AXILLARY ARTERY.

The *axillary artery* [plate 26], that part of the artery of the upper limb which intervenes between the subclavian and the brachial portions, lies obliquely upon the upper and lateral part of the thorax, extending from the outer border of the first rib to the lower margin of the tendons of the latissimus dorsi and teres major muscles. In this course it passes through the axilla or axillary space, and its direction varies with the position of the limb; when the arm hangs freely by the side, the vessel describes a curve having its concavity towards the chest; when the arm is at right angles with the trunk, the vessel is nearly straight, and if The axillary artery; its extent; direction through axilla.

the limb be still more elevated, the concavity of the curve described by the vessel is directed upwards.

Position to surface; This artery is deeply seated, except towards its termination near the floor or base of the axillary space, where it approaches the surface, and is covered only by the skin and fascia on the inner side; and here (in the arm-pit) the flow of blood through the artery may be controlled with the finger. In order to stop the circulation, the pressure should be directed outwards, as the vessel, after leaving the thorax, to bone. where it is close to the second rib, lies to the inner side of the humerus.

Immediate connections. In front, the axillary artery is covered, after having passed below the clavicle, by the pectoral muscles, (the greater pectoral lying over it in nearly the whole of its course, and the smaller muscle crossing the middle of the vessel); and beneath those muscles by the costo-coracoid membrane with the thin fascia continued downwards from it around the vessels. On the side of the chest the vessel is immediately in contact with the serratus magnus, which is to its inner side; and after reaching the arm, it rests against the subscapular muscle, the latissimus dorsi and teres major (the muscles being behind the vessel); to the outer side is the coraco-brachialis muscle. Artery is near surface at lower end. Towards its lower end the artery is covered, on its inner side, only by the integument and fascia, exclusive of the vein and nerves, the position of which is now to come under consideration.

Axillary vein over artery. The axillary vein [plates 27, 28] lies in a great measure in front of the artery with an inclination to the inner or thoracic side. The vein is immediately in contact with the fascia continued from the costo-coracoid membrane over the vessels and nerves; the fascia is, in fact, adherent to it. Two small veins in some instances run along the side of the artery in the manner of venæ comites. Cephalic vein. The cephalic vein [plate 27] crosses over the artery near the upper end to terminate in the axillary vein; and some veins from the neighbouring muscles will likewise be found crossing it in the same way.

Brachial nerves; *Nerves.*—At the upper part of the axilla the brachial nerves lie to the outer side of the artery; about the middle plexus surrounds the artery. of the space the plexus of nerves surrounds the artery, one root of the median nerve crossing before the vessel, and immediately in contact with it. Below this, the nerves emanating from the plexus are placed at different sides of the artery, and the position they bear to the vessel may be stated as follows, viz. behind it, the circumflex and musculo-

spiral; to its inner side, the ulnar and the two internal cutaneous; to the outer side, the external cutaneous and median. The external cutaneous and the circumflex nerves leave the artery in the axilla, and at the lower part of the space or the arm-pit the median nerve is often before the vessel; in an operation, that nerve might serve as a guide to the position of the artery, for it could be distinguished from the other large nerves (ulnar and musculo-spiral) by the circumstance of its being the nearest to the pectoral muscle. Median nerve.

Peculiarities.—The most important peculiarity in the trunk of this vessel consists in its giving off a much larger branch than usual,—an arrangement which has been observed in one case in every ten [op. cit., p. 226 & seq.]. In one set of cases, this large branch formed one of the arteries of the fore arm; most frequently the radial (about 1 in 33), sometimes the ulnar (1 in 72), and, rarely, the interosseous artery (1 in 506). In another set of cases, the large branch gave origin to the subscapular, the two circumflex, and the two profunda arteries of the arm; but sometimes only one of the circumflex, or again, only one of the deep humeral arteries arose from the common trunk. In this second class of cases the divisions of the brachial plexus surround the common trunk of the branches instead of the main vessel [plate 30, fig. 2]. Peculiarities of axillary; gives either an artery of fore arm; or large muscular branch.

Branches.—The axillary artery, fig. 143, A, gives off several branches, which supply the neighbouring structures. They consist of the branches furnished to the muscles on the chest (external thoracic); a large branch to the shoulder (subscapular); and two to the upper part of the arm (anterior circumflex and posterior circumflex). The branches are not constant in their number, size, or mode of origin. Branches of axillary.

EXTERNAL THORACIC BRANCHES.

These branches [plate 26] vary much in number; but, after the method of Haller,* four are usually described.

The *superior thoracic* artery (thoracica suprema: prima,—Haller), a branch of inconsiderable size, *a*, arises just above the border of the pectoralis minor, from the axillary artery itself, or, perhaps, as frequently from the next branch, the acromial thoracic. It inclines forwards and inwards, getting between the pectoral muscles, to which it is distributed; some of its branches anastomose with those of the internal mammary and intercostal arteries in the first and second intercostal spaces. Superior thoracic artery.

* Icones Anatomicæ. Fascic. VI.

Acromial thoracic artery.

The *acromial thoracic* artery (art. thoracica humeraria : acromialis,—Haller), *b*, arises from the fore part of the axillary artery, being rather a large offset, and by far the most constant of the thoracic branches. It projects forwards at the upper border of the pectoralis minor, and soon divides into branches, which take opposite directions. One set inclines inwards to the thorax, and the other outwards to the acromion, whence the vessel derives its name. The thoracic branches are two or three in number, and are distributed to the serratus magnus and pectoral muscles, their extreme ramifications communicating with those of the other thoracic branches, as well as with the intercostal branches of the internal mammary artery. The acromial branches incline outwards, and subdivide into a descending and transverse set. The latter proceed towards the acromion, and are distributed partly to the deltoid muscle; whilst others, upon the upper surface of that process, maintain an anastomosis with branches of the suprascapular and posterior circumflex arteries. A descending branch passes down in the interval between the pectoralis major and deltoid, accompanying the cephalic vein and ramifying in both muscles [plate 26].

its thoracic branches;

its acromial branches;

humeral branch.

Fig. 143.*

* The axillary and brachial arteries are shown with the shoulder and arm separated from the trunk of the body. 1. Subscapularis. 2. Latissimus dorsi with teres major. 3. Coraco-brachialis. 4. Biceps. 5. Triceps, its long head; and 6, its short head.—Arteries: A. Axillary. B. Brachial. *a*, *b*, *c*, *d*. External thoracic branches. *e*. Subscapular, and *f*, its dorsal branch. *g*. Posterior circumflex. *h*. Anterior circumflex. *i*. Superior profunda. *k*. Inferior profunda. *l*. Anastomotic.

The *long thoracic* artery (thoracica altera major sive longior,—Haller), *c*, is directed downwards and inwards, along the lower border of the pectoralis minor, and is distributed to the mamma (hence it has been called *external mammary*), to the serratus and pectoral muscles, and anastomoses with the external branches of the intercostal arteries. This vessel sometimes arises with the acromial, and occasionally with the subscapular. Long thoracic, or external mammary.

The *alar thoracic* branch (alaris, ultima thoracicarum,—Haller), *d*, when it exists, for it appears to be generally wanting and its place to be supplied by branches from the thoracic and subscapular arteries, is a very small vessel. It is distributed to the lymphatic glands and the fatty tissue in the axilla. Alar thoracic artery.

SUBSCAPULAR ARTERY.

The *subscapular* (scapularis inferior aut infrascapularis, —Haller), *e* [plate 26], is the largest branch given off by the axillary artery. It arises from that vessel, close by the lower border of the subscapular muscle, along which it proceeds downwards and backwards, soon becoming considerably diminished in size, owing to its giving off a large branch to the dorsum of the scapula. The continuation of the vessel passes down towards the inferior angle of the scapula, accompanied by the subscapular nerve, and lying on the muscle of that name, to which it gives branches, as well as to the serratus magnus, teres major and latissimus dorsi muscles. Its final ramifications anastomose with those of the posterior scapular artery, and with its own dorsal branch. Subscapular artery.

Fig. 144.*

* A sketch to illustrate the arteries on the back part of the shoulder. The dorsum of the scapula and a part of the humerus are shown.

Dorsal branch (dorsalis scapulæ).

The *dorsal* branch (*dorsalis scapulæ*), fig. 144, *d* [plate 19], turns back from the subscapular artery, about an inch and a half from its origin, and may be larger than the continuation of the vessel. Descending along the lower border of the scapula, the dorsal branch passes first through the interval between the subscapularis and latissimus dorsi muscles, and then between the teres major and teres minor, and may be found in the interval between the last-named muscles, immediately behind the long head of the triceps [plate 29, fig. 1]. It gives several branches to these muscles, one of which descends between the teres major and teres minor towards the lower angle of the scapula. The dorsal artery next turns round the lower border of the scapula, which is frequently grooved to receive it, passing beneath the teres minor; and on reaching the dorsum of that bone, ramifies extensively upon it in the infraspinous fossa beneath the infraspinatus muscle which it supplies, and ultimately anastomoses with the suprascapular and posterior scapular arteries.

Infra-scapular branch.

From the subscapular artery (its dorsal division) is given a slender branch, which enters the subscapular fossa under the subscapularis muscle, and, after ramifying between that muscle and the bone, anastomoses with other slender branches given to the same surface of the scapula from the suprascapular and the posterior scapular arteries [plate 29, fig. 2].

CIRCUMFLEX ARTERIES.

The circumflex arteries.

The two succeeding branches of the axillary artery belong to the arm, and are called *circumflex*, from the manner in which they wind round the neck of the humerus. They are distinguished as anterior and posterior from the course they take respectively around the bone. These branches come off close to the lower border of the subscapularis muscle.

Posterior.

The *posterior circumflex* artery, fig. 143, *g*, is not so large as the subscapular, near which it arises [plate 26]. It takes origin opposite to the lower border of the subscapular muscle, passes backwards immediately after its origin, and

Infraspinatus muscle cut. 2. Teres minor. 3. Teres major. 4. Part of long head of triceps.—Arteries: *a*. Suprascapular. *b*. Posterior scapular. *c*. Branch of subscapular. *d*. Dorsal branch of the subscapular: it lies under the teres minor, not over it as represented in the woodcut. *e*. Posterior circumflex.

winds round the humerus [plate 29], lying between the bone and the long head of the triceps, having the teres major muscle below, and the teres minor above it, fig. 140, *e*, and being accompanied by the circumflex nerve. This artery terminates by ramifying in the deltoid muscle and on the shoulder-joint, and by anastomosing with the anterior circumflex and suprascapular arteries, as well as with the acromial thoracic.

The *anterior circumflex*, fig. 143, *h*, much smaller than the preceding, arises somewhat lower down, and from the outer side of the axillary artery. It passes from within outwards and forwards, under the inner head of the biceps and the coraco-brachialis muscle, resting on the fore part of the humerus [plate 29, fig. 2], until it reaches the bicipital groove. There it divides into two branches, or, in some cases, into two sets of branches; one of these ascends by the long head of the biceps through the groove in which this lies, and is distributed to the head of the bone and the capsule of the joint: the other continues outwards in the original direction of the vessel, and anastomoses with the posterior circumflex branch. Anterior.

Peculiarities of the branches.—The *external thoracic* arteries are, it has been already stated, most frequently three in number, the alar thoracic being wanting: often there are only two, the superior and the acromial thoracic arising by a single trunk: the number may vary to a still greater extent, for there may be four or five; or only one, from which the usual branches are then given off. Varieties in branches. Thoracic.

The subscapular artery.—The peculiarities affecting the subscapular and circumflex arteries are extremely various, and can be only generally indicated here. The most common change in the *subscapular* consists in its giving off one or more of the vessels usually derived from the axillary. Most commonly the posterior circumflex is thus joined with it; and less frequently a large thoracic branch [plate 30, fig. 1]. If there be two or more vessels arising with the subscapular, these may be the posterior circumflex and a thoracic artery, or both circumflex, or both circumflex with a thoracic branch. Again, one or more of the associated vessels may belong to those usually derived from the brachial; so that both profunda arteries, or the superior profunda alone, may arise together with both circumflex, or with the posterior circumflex only, from this common subscapular trunk [plate 30, fig. 2]. In very rare cases the anastomotic, the interosseous [plate 33, fig. 1], or the radial [plate 30, fig. 3], have been also added to the subscapular. Lastly, the subscapular sometimes arises by two trunks,—the dorsal scapular branch springing directly from the axillary artery. Subscapular and circumflex are frequently associated.

The circumflex arteries.—Besides their occasional association with the subscapular, the circumflex arteries present other peculiarities, the most frequent of which consists in the removal of the posterior circumflex from the axillary to the superior profunda (a branch of the Varieties in circumflex branches.

brachial), in which case it ascends behind the tendons of the latissimus dorsi and teres major [plate 31, fig. 1]. In another class of cases, not quite so numerous, the posterior circumflex gives off one or more branches usually derived from other sources: as for example, placing them in the order of frequency—the anterior circumflex, the superior profunda, the dorsal scapular, the anterior circumflex, with the superior profunda [plate 30, fig. 1], or some other rarer combination of those vessels. The posterior circumflex is sometimes double; and so is the anterior, but more seldom [op. cit. p. 231].

Branches of axillary deficient, In the cases just mentioned as being rather frequent, in which the posterior circumflex arises from the superior profunda, it is evident that the axillary artery loses one of its ordinary branches: in other rare cases these are present with the additional branch supplying the or increased in number. place of one or two usually derived from other sources, or constituting what has been named a "vas aberrans," to be hereafter again alluded to.

BRACHIAL ARTERY.

Brachial artery. The brachial or humeral artery, fig. 143, B [plate 26], the continuation of the axillary, is placed along the inner Extent. and anterior aspect of the arm, extending from the lower border of the posterior fold of the axilla, to about a finger's Direction. breadth below the bend of the elbow, or opposite the neck of the radius, where it divides into the radial and ulnar arteries. The vessel gradually inclines from the inner side to the fore part of the limb; and its direction may be marked out by a line drawn from midway between the folds of the axilla to the middle point between the condyles Position with respect to bone. of the humerus. From the position it bears with reference to the bone, it will be inferred that to command the flow of blood through the artery at its upper part, pressure should be directed outwards, while over the lower end of the vessel the pressure should be made from before backwards. The position of the artery in the greater part of its course is also indicated by the depression along the inner border of the coraco-brachialis and biceps; and, except at the bend of Is entirely superficial. the elbow, or where it is slightly overlaid by those muscles in the arm, it may be said to be superficial in its whole extent. It can be laid bare without dividing any muscular fibres.

Connections. The brachial artery is covered by the integument and fascia of the arm as far as the bend of the elbow, where it sinks deeply in the interval between the pronator teres and supinator longus muscles, and is covered by the fibrous expansion given from the tendon of the biceps to the fascia of the fore arm. It rests at first on the triceps muscle,—the musculo-spiral nerve however, and the superior profunda artery intervening, then crosses over the insertion of

the coraco-brachialis muscle, and lies thence to its termination on the brachialis anticus. At its outer side the artery is in apposition with the coraco-brachialis, and afterwards, and for the greater part of its length with the biceps, the inner border of one or both muscles sometimes slightly overlapping it.*

Veins.—The basilic vein [plate 27] is placed over or to the inner side of the brachial artery for the lower half, sometimes the whole length, and at the bend of the arm the median basilic crosses over the artery. Only the fascia, or opposite the elbow-joint the expansion from the tendon of the biceps, is interposed between the vein and artery [plate 40]. Venæ comites are in close contact with the artery, short transverse branches of communication passing from one to another, so as at many points to encircle it.

Basilic vein, and median basilic before artery.

Nerves.—The median nerve [plate 26] follows closely the course of the artery, lying immediately in front of it below the middle (in length) of the arm ; at the axilla this nerve is on the outer side of the vessel, but at the elbow it lies to the inner side and on the same plane, both being supported by the brachialis anticus muscle. The nerve usually crosses in front of the artery, but in some instances behind it.—Of the large branches of the brachial plexus which are closely connected with the axillary artery, none continue in the immediate neighbourhood of the brachial artery along the arm, except the median. The external cutaneous and circumflex separate at once from the vessel in the axilla, the musculo-spiral soon turns back below the axilla, and the internal cutaneous and the ulnar incline gradually inwards from the vessel,—or perhaps more properly the vessel turns outwards from the nerves.

Median nerve accompanies artery.

Other brachial nerves leave artery in different positions.

Peculiarities.—From their comparative frequency and surgical interest, the peculiarities of this artery, especially such as affect its trunk, deserve particular attention.

The trunk of brachial artery ;

The brachial artery has been seen, though rarely, to deviate from its ordinary course in the following manner. At first it descends, accompanied by the median nerve, towards the inner condyle of the humerus, as far as the origin of the pronator teres muscle, which is broader than usual, and then it inclines outwards under cover of or through that muscle, to gain its usual position at the bend of the elbow. In these cases the vessel may be found to turn round a prominence of bone, to which it is bound down by a fibrous band [plate 36, fig. 3]. This

deviates from usual course ;

* For an account of certain unusual bands of muscle found in connection with this artery—crossing over it—see p. 87.

deviation of the artery and its connection with the bony prominence, may be regarded as analogous to the ordinary condition of the vessel in some carnivorous animals, in which it is directed to the inner side of the humerus, and passes through an osseous ring, a short distance above the inner condyle of that bone.

The artery slit.

As an extremely rare condition, the artery has been found slit near its commencement like the femoral trunk, the artery being single above and below [plate 34].

Fore arm arteries arise together.

In one case the three arteries of the fore arm sprang together from the end of the brachial trunk at the usual distance below the elbow—the arteries of the two limbs being alike in this particular: in this example the brachial artery had the unusual course above described.

Its point of division.

The most frequent change from the ordinary arrangement of the brachial artery relates to its place of division into terminal branches. In 386 out of 481 examples recorded from observations made, some on the right and some on the left side of the body, the vessel was found to divide at its usual position, a little below the elbow-joint. In one case only (and that complicated by another peculiarity, viz. the existence of a "vas aberrans" proceeding from the axillary to the radial,) was the place of division lower than usual, or between two and three inches lower than the elbow-joint [plate 35, fig. 4]. In 64 cases the brachial artery divided *above* the usual point, at various heights upwards to the lower border of the axilla. The branch prematurely given off from an early division is most frequently (in the proportion of nearly 3 cases out of 4) the radial artery, sometimes the ulnar is thus given off, and rarely the interosseous of the fore arm, or a "vas aberrans." [Op. cit. p. 260.]

Two arteries in arm.

In all the cases of high origin it is evident that *two* arteries must exist in a certain portion of the arm, instead of the usual one;* and the extent to which they are found varies, of course, according to the height at which the artery divides. The point of division in the entire number of cases, without reference to the particular branch given off, was most frequently in the upper, less so in the lower, and least so in the middle third of the arm. But the early division of the main artery of the upper limb may, as mentioned in speaking of the varieties of the axillary artery, take place within the axilla, in which case it follows that the brachial portion of the vessel is represented, throughout its whole extent, by two separate trunks. In 94 cases out of 481, or about 1 in $5\frac{1}{9}$, there were two arteries instead of one in some part or in the whole of the arm [p. 263].

Proportionate frequency.

Position of these two arteries;

The position of the two arteries, in these cases, is of much surgical interest: we shall here consider their position in the arm, and subsequently trace them in their irregular course in the fore arm. Usually they are close together, and occupy the ordinary position of the brachial artery; but there are some peculiarities in their position which require to be noticed.

of the radial;

The *radial* artery, when thus given off in the arm, often arises from the inner side of the brachial, then runs parallel with the larger vessel (the brachial or ulnar-interosseous), and crosses over it, sometimes

* In one instance only, the *three* arteries of the fore arm (radial, ulnar, and interosseous,) arose together from the brachial artery at some distance above the elbow-joint [plate 33, fig. 3]. A similar case is recorded by Dr. Barclay.

suddenly, opposite the bend of the elbow, still covered by the fascia [plate 31]. It has been found to perforate the fascia, and run immediately under the skin, near the bend of the elbow [plate 41, fig. 4]; but very few instances of this arrangement have been recorded.

When the *ulnar* is the branch given off high from the brachial, it often inclines from the position of the brachial, at the lower part of the arm, towards the inner condyle of the humerus [plate 32]. This vessel generally lies beneath the fascia as it descends, and superficially to the flexor muscles. It is occasionally placed between the integuments and the fascia [plate 36, fig. 1]; and in a single instance was found beneath the muscles [fig. 2]. of the ulnar;

The *interosseous* [plate 33], after arising from the axillary or brachial artery, is commonly situate behind the main artery, and, on reaching the bend of the elbow, passes deeply between the muscles, to assume its usual position in the fore arm. of the interosseous;

Lastly, when the radial has arisen high in the arm, the residuary portion of the brachial (*brachial: ulnar-interosseous*) has occasionally been observed descending, accompanied by the median nerve, along the intermuscular septum towards the inner condyle of the humerus, as far as the origin of the pronator teres (which in the cases recorded was found broader than usual), whence it turned outwards under cover of the muscle, to gain the usual position at the middle of the bend of the elbow [plates 36, 37]. of the main trunk.

The two arteries connected or re-united.—The two arteries representing the brachial are in some instances *connected* near the bend of the arm by an intervening trunk, which proceeds from the larger (or ulnar-interosseous) artery to the radial, or the radial recurrent, and varies somewhat in its size, form, and course. More rarely the two unusual arteries are actually *re-united* [plate 34]. Two arteries are sometimes connected, or even re-united.

The *aberrant arteries*, "vasa aberrantia" [plate 35], alluded to in the preceding remarks, are long slender vessels, which arise either from the brachial or the axillary artery, and end by joining one of the arteries of the fore arm, or a branch of these. In eight cases out of nine,—the total number observed, this unusual vessel joined the radial; in the remaining case it joined the radial recurrent, which arose irregularly from the ulnar artery. Monro and Meckel have each seen one case in which the aberrant vessel joined the ulnar. This peculiarity may be regarded, perhaps, as an approach to that condition in which there is division of the brachial artery and subsequent connection of its two parts by an intervening branch. Vasa aberrantia; origin; termination.

State of the arteries in both limbs.—In most cases there is no correspondence between both arms of the same person with respect to the high division of the arteries. For, in 61 bodies in which the high division existed, it occurred only on one side in 43; on both sides, in different positions, in 13; and on both sides, in the same position, in the remaining 5. [Op. cit. p. 266.] No correspondence between arteries of both arms.

Branches.—The brachial artery gives some unnamed branches, which are directed outwards and backwards to the muscles in its immediate neighbourhood, viz. to the coraco-brachialis, biceps, and brachialis anticus; the following, which incline inwards, have received names, and require description. Branches.

SUPERIOR PROFUNDA AND NUTRIENT ARTERY.

Superior profunda.

The superior profunda artery (collateralis magna), fig. 143, *i* [plate 26], arises from the inner and back part of the brachial, just below the border of the teres major, and inclines backwards, to reach the interval between the second and third heads of the triceps muscle. It is accompanied by the musculo-spiral nerve, and both, continuing the same oblique direction, enter the spiral groove which winds round the back of the humerus, passing between it and the triceps, and perforating the external intermuscular septum to reach the external and anterior aspect of the bone. In the latter situation, the artery lies deeply in the interval between the brachialis anticus and spinator longus muscles, considerably diminished in size by having given off several branches, and descends to the elbow, where it anastomoses with the recurrent branch of the radial artery. The superior profunda in its first part gives off branches to the deltoid, coraco-brachialis, and triceps; and many to the last-named muscle, whilst it is between it and the bone. In this position it also gives one long branch, which descends perpendicularly between the muscle and the bone to the back part of the elbow-joint on the outer side, where it anastomoses with the interosseous recurrent branch; and another which anastomoses on the inner side with the ulnar recurrent, and the anastomotic or the inferior profunda [plate 42, fig. 1, 2].

Winds behind humerus.

Branches.

Peculiarities of superior profunda.

Peculiarities.—The most frequent departure from the usual disposition of the superior profunda consists in its giving origin to the posterior circumflex, which is usually a branch of the axillary. Not quite so frequently its own origin is transferred to one of the branches of the axillary; as, for example, to the subscapular, which then also gives off one or both circumflex; or to the posterior circumflex, which then gives origin to the anterior circumflex, or some other branch. The superior profunda sometimes arises from the axillary artery itself, either alone, or in conjunction with the inferior profunda. Lastly, it is occasionally represented by two, or even three separate branches. It not unfrequently furnishes the inferior profunda.

Nutrient branch to humerus.

The principal *nutrient artery* of the shaft of the humerus is a very small branch, and is given off by the brachial about the middle of the arm, or by one of its collateral branches. It inclines downwards, enters the oblique canal in the humerus near the insertion of the coraco-brachialis muscle, and is distributed in the interior of the bone.

INFERIOR PROFUNDA.

The inferior profunda artery (collateralis ulnaris prima), fig. 143, *k* [plate 26], is of small size, and arises from the brachial artery a little below the middle of the arm. From the point just indicated, the artery is directed to the back part of the inner condyle of the humerus; to gain this position, it pierces in the first place the intermuscular septum, and then lies on the inner surface of the triceps (the third head), giving this branches. In this course the artery lies close to the ulnar nerve, and enters the interval between the olecranon and inner condyle, where it terminates by inosculating with the posterior recurrent branch of the ulnar artery, and with the anastomotic branch. Inferior profunda. Ending.

Peculiarities.—As already incidentally mentioned in the account of other branches, this artery often arises from the superior profunda, or from the axillary artery in combination with some other branch. It is occasionally altogether wanting. Owing to these frequent changes of condition the inferior profunda has not been recognised by some anatomists. Peculiarities of inferior profunda.

ANASTOMOTIC BRANCH.

The anastomotic artery (collateralis ulnaris secunda), fig. 143, *l* [plate 26], though a small branch, is very constant in its existence. Arising from the brachial artery about two inches above the bend of the arm, it is directed transversely inwards on the brachialis anticus muscle, above the inner condyle of the humerus, and, after perforating the intermuscular septum, turns in the opposite direction outwards behind the humerus, between the bone and the triceps muscle. In this situation the artery ends by joining with the superior profunda, the two forming an arch across the humerus immediately above the olecranon fossa (arcus dorsalis humeri posticus,—Haller) [plate 42, fig. 2]. Anastomotic artery. Arch behind humerus.

In front of the humerus the anastomotic artery furnishes a branch which ramifies in the pronator teres, and anastomoses with the anterior ulnar recurrent branch. Behind the inner condyle another offset joins with the posterior ulnar recurrent, and behind the humerus several branches are given to the joint and the muscle. Branches.

Peculiarities.—The anastomotic artery is sometimes much reduced in size, and in that case the inferior profunda takes its place behind the humerus.

Ending of brachial.

Ending of the brachial artery.—A little below the middle of the elbow-joint, or opposite the neck of the radius, the brachial artery divides into its two terminal branches—radial and ulnar. Of these the radial artery appears, as far as direction is concerned, the continuation of the parent vessel, but the ulnar is the larger of the two.

ULNAR ARTERY.

Ulnar artery.

Extent;

The ulnar artery, fig. 145, B [plates 38, 39], extends from the point of bifurcation of the brachial just indicated, along the inner side of the fore arm into the palm of the hand, where joining a branch of the radial, opposite the muscles of the thumb, it forms the superficial palmar arch. In this course it inclines at first downwards and inwards, describing a slight curve, the convexity of which is directed inwards, and passes under cover of the superficial muscles arising from the inner condyle of the humerus, viz. the pronator teres, flexor carpi radialis, palmaris longus, and flexor sublimis, until it reaches the flexor carpi ulnaris about the junction of the upper with the middle third of the fore arm; at this point the artery comes into contact with the ulnar nerve, which was previously separated from it by a considerable interval, and changing its direction, descends vertically with the nerve towards the inner border of the palm of the hand. Guided as it descends by the tendon of the flexor ulnaris muscle, along the radial border of which it is now placed, the ulnar artery reaches the outer or radial side of the pisiform bone, where, still accompanied by the nerve, it passes over the cutaneous surface of the anterior annular ligament of the wrist into the palm of the hand. Its disposition in the hand will be separately described.

direction; at first inwards, then downwards, close to tendon of flexor carpi ulnaris.

Connections in the fore arm; is superficial below.

In the first half of its course through the fore arm, the artery is deep-seated, being covered by the muscles arising from the inner condyle of the humerus which have been already enumerated. About the middle of the fore arm it is overlapped by the fleshy flexor carpi ulnaris; but below that, it becomes more superficial, being overlaid by the tendon of the muscle, and covered by the skin, the fascia of the fore arm, and a thin layer of membrane by which the vessel is bound down to the muscle beneath.* At first the

* For an account of some muscular fibres which sometimes cover the lower part of the ulnar artery, see p. 94, and [plate 45, fig. 2].

ulnar artery rests on the insertion of the brachialis anticus into the coronoid process of the ulna; then on the flexor profundus in the rest of the fore arm, and lastly, on the annular ligament of the carpus. Below the point at which it emerges from under the flexor carpi ulnaris, (or a little below the middle of the fore arm,) the tendon of that muscle is on its inner or ulnar side.

Nerves.—The median nerve lies immediately on the inner side of the ulnar artery at the origin, but it soon passes over the vessel, and is then separated by the second head of the pronator teres muscle. As the ulnar nerve descends behind the inner condyle of the humerus, it is removed from the ulnar artery by a considerable interval at the upper part of the fore arm; but as the vessel inclines inwards, it approaches the nerve, and is accompanied by this in the lower half of its course—the nerve lying close to its inner side. A small branch of the ulnar nerve descends upon the lower part of the vessel.

Connection with nerves,

especially with ulnar;

Veins.—Two veins (venæ comites), which have the usual arrangement of such veins, accompany the ulnar artery.

with veins.

At the wrist the ulnar artery rests on the anterior annular ligament, and is covered by the skin and fascia, and by a tendinous band from the flexor carpi ulnaris to that ligament. The pisiform bone is to its inner side; the ulnar nerve is also on the same side, but somewhat behind the artery.

On annular ligament.

Peculiarities.—Most of the peculiarities have reference to the *place of origin* of the artery, a subject already alluded to in the description of the variations observed in the branches of the axillary, and in the place of bifurcation of the brachial artery. In a considerable number of observations, the ulnar artery was found to deviate, in regard to its *origin*, in nearly the proportion of 1 in 13. In all cases but one (in which it arose between two and three inches below the elbow-joint, in consequence of a late bifurcation of the brachial artery [plate 35, fig. 4]), the place of origin of the ulnar artery was higher than usual [plate 32]. Moreover the brachial was, more frequently than the axillary, the source from which it sprang; indeed, the examples of its origin from the trunk at different parts appeared to decrease in number upwards.

Peculiarities of ulnar artery;

in origin;

The *position* of the ulnar artery in the fore arm is more frequently altered than that of the radial. When it arises in the usual way, the course of this artery is not often changed; but it has been seen to descend apart from the tendon of the flexor carpi ulnaris, instead of being close to its radial border [plate 43, fig. 3].

in position;

The position of the ulnar artery in the upper arm, when it arises high up, has been previously adverted to (page 291). In the fore arm it almost invariably descends, in cases of premature origin, over the

in reference to muscles, fascia, and skin;

muscles arising from the inner condyle of the humerus, only one exception to this rule having been met with [plate 36, fig. 2]. Most commonly it is covered by the fascia of the fore arm [plate 32]; but now and then a case occurs in which the vessel rests on the fascia, and is subcutaneous [plate 36, fig. 1]. In a very few instances the artery lay partly beneath the skin, and partly beneath the fascia, being subcutaneous for a short distance in the upper part of the fore arm, and subaponeurotic lower down [plate 41, fig. 2].

Fig. 145.*

in size.

As to *size*, the ulnar artery presents some peculiarities which, being accompanied by deviations of an opposite and compensating character in the radial artery, will be noticed with that vessel.

Branches of ulnar in the arm.

Branches.—In the fore arm and on the wrist, the ulnar artery gives off several branches, which have received particular names. The branches in the fore arm are the anterior and posterior recurrent, the interosseous, and several muscular branches. Those given at the wrist are named carpal branches (anterior and posterior).

RECURRENT BRANCHES.

Anterior ulnar recurrent.

The *anterior ulnar recurrent* artery, fig. 145, *c*, arches inwards from the upper part of the ulnar artery, running on the brachialis anticus muscle, and covered by the pronator teres, both which muscles it partly supplies. On reaching the front of the inner condyle, it anastomoses with the inferior profunda and anastomotic arteries, derived from the brachial [plate 42, fig. 1].

* The lower end of the brachial artery and the arteries on the front of the fore arm and hand are shown without removal of any muscle. 1. Biceps muscle. 2. Supinator longus. 3. Pronator teres. 4. Radial flexor of carpus. 5. Long palmar. 6. Superficial flexor of fingers. 7. Ulnar flexor of carpus.—Arteries: A. Brachial. B. Ulnar. C. Radial. D. Superficial palmar arch.—Branches: *a*. Inferior profunda.

The *posterior ulnar recurrent* is larger than the preceding, and comes off lower down; though not unfrequently the two arise by a short common trunk. The posterior recurrent runs inwards and backwards beneath the flexor sublimis, and then ascends behind the inner condyle. In the interval between that process and the olecranon it lies beneath the flexor carpi ulnaris, and passing between the heads of that muscle along the ulnar nerve, supplies branches to the muscles, to the elbow-joint, and to the nerve itself. This branch communicates with the inferior profunda, the anastomotic, and, over the olecranon, with the interosseous recurrent likewise [plate 42, fig. 2].

Posterior ulnar recurrent.

INTEROSSEOUS ARTERY.

The interosseous artery, the next and largest branch of the ulnar, is of considerable size, and is sometimes called the *common interosseous* artery from the circumstance of its forming a trunk common to two vessels named the *anterior* and *posterior* interosseous. It is a short trunk about an inch in length, which arises below the bicipital tuberosity of the radius, beneath the flexor sublimis, and passes backwards to reach the upper border of the interosseous ligament, where its division takes place.

Interosseous divides into two.

The *anterior interosseous* [plate 39] descends upon the anterior surface of the interosseous ligament, accompanied by the interosseous branch of the median nerve, and overlapped by the contiguous borders of the flexor profundus digitorum and flexor longus pollicis. Thus placed it gives off some muscular branches, and also the *nutrient* arteries of the shafts of the radius and ulna, which incline to each side and enter the oblique foramina in those bones to be distributed to the medullary membrane in their interior. The artery continues its course directly downwards until it reaches the upper border of the pronator quadratus muscle, where it gives off some small branches to supply that muscle, one of which descends to join upon the front of the carpus with the branches of the anterior carpal arteries. The larger branch of the artery, however, passes from before backwards through an opening in the interosseous ligament; and, on reaching the dorsal surface of this structure, descends

Anterior interosseous on ligament

gives nutrient branches to bones;

reaches back of fore arm.

b. Anastomotic. *c.* Anterior ulnar recurrent. *d.* Deep palmar branch. *e.* Digital. *f.* Radial recurrent. *g.* Superficial volar. *h.* Principal artery of thumb. *i.* Radial branch of index-finger.

behind it to the carpus, where it maintains communications with the posterior carpal branches of the radial and ulnar arteries. The anterior interosseous artery gives off a long slender branch, which accompanies the median nerve and sends offsets into its substance. This artery of the median nerve, or *median* artery, is sometimes much enlarged, and in this case it presents several peculiarities to be hereafter noticed.

Branch to median nerve.

Posterior inter-osseous; not on ligament;

The *posterior interosseous* artery passes backwards through the interval left between the oblique ligament and the upper border of the interosseous ligament. Continuing its course downwards along the arm [plate 40], covered by the superficial layer of extensor muscles, it gives several branches to them and the deep-seated muscles, and reaches the carpus considerably diminished in size; its terminal branches anastomose with the posterior or terminal branch of the anterior interosseous artery, and with the carpal branches of the radial and ulnar arteries.

gives off interosseous recurrent.

In addition to numerous muscular branches, which require no special notice, this artery gives off close to its origin, or as soon as it passes behind the ligament, a recurrent branch, the *posterior interosseous recurrent* [plate 42, fig. 2], which is nearly as large as the continuation of the vessel. This branch passes directly upwards, covered by the anconeus, to reach the interval between the olecranon and external condyle; at this spot it divides into several offsets which anastomose with the superior profunda and the posterior ulnar recurrent.

Muscular branches of ulnar artery.

Several *muscular* branches of the ulnar artery are distributed to the muscle in its course along the fore arm; some of these perforate the interosseous ligament to reach the extensor muscles.

CARPAL BRANCHES.

Carpal posterior;

The *posterior* or *dorsal carpal*, a branch of variable size, inclines backwards from the ulnar artery a little above the pisiform bone. It winds back under the tendon of the flexor carpi ulnaris, and reaches the dorsal surface of the carpus beneath the extensor tendons; it here gives a branch which anastomoses with the posterior carpal artery derived from the radial, so as to form the *posterior carpal arch:* after which it runs along the metacarpal bone of the little finger, and forms the dorsal branch. Sometimes this *metacarpal*

metacarpal.

branch arises as a separate vessel, the posterior carpal being then very small. From the posterior carpal arch just referred to, the second and third dorsal interosseous branches are derived.

The *anterior* or *palmar carpal* branch is a very small artery, which runs on the anterior surface of the carpus beneath the flexor profundus, anastomoses with a similar offset from the radial artery, and supplies the carpal bones and articulations. Anterior carpal.

Peculiarities in the branches.—The transverse communications which sometimes exist between the ulnar and radial arteries have been already referred to at p. 291. Peculiarities.

Branches of the ulnar in the fore arm.—The *anterior* and *posterior ulnar recurrents* frequently arise by a common trunk. When the ulnar artery has a high place of origin, its recurrent branches are derived from the common interosseous; one or both have been seen, but more rarely, to arise from the brachial. Ulnar recurrents.

The *anterior* and *posterior interosseous* arteries are occasionally given singly from the ulnar. But the common interosseous trunk is liable to much greater deviations from its ordinary course. Thus, when the ulnar arises higher up, the interosseous is associated with the radial artery, and separates from that vessel at the bend of the elbow; the trunk common to the two vessels répresents the brachial in these cases [plate 32]. Again, the interosseous itself has been found to arise above its ordinary situation, taking origin from the brachial, and even (but more rarely) from the axillary [plate 33]. The anterior interosseous presents some striking varieties of excess in its branches, usually connected with a deficiency in the radial or ulnar arteries. These cases are referred to in noticing the arteries which are thus reinforced [plate 44]. Interosseous from radial, brachial, or axillary. Aids radial, or ulnar.

Median artery.—The branch accompanying the median nerve is sometimes much enlarged, and in such case may be regarded as a reinforcing vessel. It is generally a branch of the anterior interosseous [plate 44, fig. 2], but sometimes of the ulnar [plate 43, fig. 3]; and more rarely a median branch has been met with descending from the brachial artery [plate 45, fig. 1]. Accompanying the median nerve beneath the annular ligament into the palm of the hand, the median artery ends most frequently by joining the superficial palmar arch, sometimes by forming digital branches, or by joining digital branches given from other sources. [See plate 46 and those before referred to.] The median artery varies in origin, and termination.

SUPERFICIAL PALMAR ARCH.

The superficial palmar arch or artery (arcus superficialis volæ,—Haller), fig. 145, D [plate 38], is the continuation of the ulnar artery to the hand. Changing its course near the lower border of the annular ligament, this artery turns obliquely outwards across the palm of the hand towards the middle of the muscles of the thumb, where it terminates Superficial palmar arch from ulnar; inosculates with radial.

by inosculating with a branch of the radial artery. The branch of the radial artery which joins with the ulnar, and, as it may be said, completes the arch, varies in different cases; most commonly it is a small one emerging from among the muscles of the thumb — the superficial volar. In its course across the hand, the artery describes a curve, having its convexity directed towards the fingers, and reaching downwards somewhat lower than a line on a level with the flexure of the first joint of the thumb.

Position and connections.

The superficial palmar artery rests at its commencement on the annular ligament of the wrist, and slightly on the short muscles of the little finger; then on the tendons of the superficial flexor of the fingers, and the divisions of the median and ulnar nerves, the latter nerve accompanying the vessel for a short distance. It is covered towards the ulnar border of the hand by the palmaris brevis, and afterwards by the palmar fascia and the integument.

Branches.

The *branches* given off by the superficial palmar arch, which are generally numerous, are as follow:

Deep branch.

The *deep* or *communicating* branch (cubitalis manûs profunda,—Haller), fig. 145, *d*, arises from the ulnar artery at the commencement of the palmar arch, a little beyond the pisiform bone, sinks deeply between the flexor brevis and the abductor of the little finger, and then inosculates with the palmar termination of the radial artery, thereby completing the deep palmar arch.

Others to palm.

Small branches, some following a retrograde course to the annular ligament, are given off to the parts in the palm of the hand from the upper or concave side of the palmar arch.

Digital arteries to three fingers and a half.

The *digital* branches, usually four in number, *e*, *e*, proceed downwards from the convexity of the palmar arch to supply both sides of the three inner fingers, and the ulnar side of the fore finger. The *first digital* branch inclines inwards to the ulnar border of the hand, and after giving minute offsets to the small muscles of the little finger, runs along the inner margin of its phalanges. The *second* runs along the fourth metacarpal space, and at the root of the fingers divides into two branches, which proceed along the contiguous borders of the ring finger and little finger. The *third* is similarly disposed of to the ring finger and middle finger; and the *fourth* to the latter and the index finger. The radial side of the index finger and the thumb are supplied from the radial artery.

The digital arteries placed at first superficial to the tendons, then lie between them, accompanied by the digital nerves as far as the clefts of the fingers, where they are joined by the anterior interosseous arteries, branches of the deep arch. On the sides of the fingers, each artery lies beneath the corresponding nerve, and gives branches which supply the sheaths of the tendons, and the joints, some of them anastomosing across the front of the bones with similar branches from the opposite side. At about the middle of the last phalanx, the two branches for each finger converge and form an arch, from which proceed numerous small offsets to supply the matrix of the nail and all the structures at the tip of the finger. Course. They join on last phalanx.

The *peculiarities* observed in the branches of the superficial palmar arch will be noticed after the description of the deep arteries of the hand. Peculi-arities.

RADIAL ARTERY.

The *radial artery*, fig. 145, c [plates 38, 39], in direction, though not in size, appears to be the continuation of the brachial. . It extends from the bifurcation of the latter, obliquely along the front of the fore arm as far as the lower end of the radius, below which it turns round the outer border of the wrist ; and then descending to the back of the space between the metacarpal bones of the thumb and fore finger, passes forwards into the palm of the hand, which it crosses towards the inner side, so as to form the deeper palmar arch. From the change in its course to the lower end, the direction and connections of the radial artery may be separately described in the fore arm, on the wrist, and in the hand. Radial artery. Extent; curves at lower end.

In the fore arm, the direction of this artery is from the point of bifurcation of the brachial opposite the neck of the radius towards the fore part of the styloid process of that bone. It descends at first somewhat obliquely outwards in a line with the brachial artery, and then nearly vertically along the outer part of the front of the fore arm, its course being indicated by a line drawn from the middle of the bend of the elbow to the narrow interval between the trapezium bone and the tendons of the extensors of the thumb, which can be readily felt towards the outer border of the wrist. Placed at first to the inner side of the radius, the vessel gradually inclines to the front of that bone, on Its direction in the fore arm. Position in reference to bone;

to the surface; to muscles;

which it lies below; it is in this part of the vessel that the pulse is usually felt during life. The radial artery is nearer to the surface than the ulnar, and is covered only by the common integument and fascia, except where it is overlapped by the fleshy part of the supinator longus, [2], which must be drawn aside in order to bring the vessel into view. At first it rests on the tendon of the biceps, and is then supported by the fatty tissue contained in the hollow in the front of the elbow, which separates it from the short supinator muscle. It next passes over the insertion of the pronator teres, and the thin radial origin of the flexor sublimis; after which, it lies on the flexor pollicis longus and pronator quadratus, until it reaches the lower end of the radius. To the inner side of this vessel lie the pronator teres in the upper part of its course, and the flexor carpi radialis in the remainder, and on the outer side, in its whole course along the fore arm, is the supinator longus muscle.

to veins.

Veins.—The artery is accompanied by venæ comites, which have the usual arrangement of those veins.

Radial nerve. External cutaneous nerve.

Nerves.—The radial branch of the musculo-spiral nerve is placed on the outer side of the artery in the middle third of its course. At the elbow that nerve is separated from the artery by a considerable interval; and towards the lower end of the fore arm it turns backwards beneath the tendon of the supinator longus, to reach the dorsal aspect of the limb, and thus loses all connection with the artery. Some filaments of the external cutaneous nerve pierce the fascia to reach the lower part of the artery, which they accompany to the back of the carpus.

The radial artery at the wrist; course and connections.

At the wrist, the radial artery turns outwards between the styloid process of the radius and the carpus, beneath the tendons of the extensors of the metacarpal bone and first phalanx of the thumb, and upon the external lateral ligament of the wrist-joint, to reach the back of the carpus. It then runs downwards for a short distance, lying in the angular interval between the tendons of the two extensors of the thumb just alluded to, and that of the extensor of the second phalanx; and soon, being crossed by this last-named tendon, the vessel reaches the upper end of the space between the first and second metacarpal bones, where it turns forwards into the palm of the hand, by passing between the heads of the first dorsal interosseous muscle.

As it turns round below the end of the radius the artery

is deep-seated, but afterwards comes nearer to the surface. It is accompanied by two veins and by some filaments of the external cutaneous nerve, and is crossed by subcutaneous veins and by filaments of the radial nerve. Veins and nerves.

Peculiarities.—From the usual *place of origin* the radial was found, in 429 observations, to deviate in the proportion of nearly 1 case in 8. In all it arose higher than usual [plate 31], with the exception of one case of low division of the brachial artery, and in this the radial artery was joined by a vas aberrans [plate 35, fig. 4]. The brachial artery (most commonly near its upper end) was the source from which the radial proceeded in case of high origin much more frequently than the axillary [op. cit. p. 317]. Origin higher than usual.

The *position* of this artery in the upper arm, in the case of its premature origin, having been already mentioned (p. 290), it remains only to examine the peculiarities of its course in the fore arm. The radial artery more rarely deviates from its usual position along the fore arm than the ulnar.—It has, however, been found lying upon the fibrous expansion from the tendon of the biceps, and over the fascia of the fore arm, instead of beneath those structures [plate 41, fig. 4]. This vessel has been also observed to be placed on the surface of the long supinator, instead of on the inner border of that muscle [plate 42, fig. 5]. In turning round the wrist, it has been likewise seen to deviate from its ordinary course by passing over the extensor tendons of the thumb, instead of beneath them [plate 42, fig. 4]. But these several peculiarities are of very rare occurrence. As was previously stated, (p. 291), the vasa aberrantia occasionally derived from the brachial or axillary arteries most commonly end by joining the radial, or one of its branches. Peculiarities of position in fore arm; over fascia or muscles, but very rarely; joined by vas aberrans.

SOME VARIATIONS IN THE ULNAR AND RADIAL ARTERIES COMPARED.

Some of the peculiarities observed in these vessels may be usefully contrasted with each other.

In the first place, it has been found that the radial artery much more frequently deviates in some important particular from its usual condition than the ulnar, the proportion in a large and about an equal number of cases being about 1 in $4\frac{1}{2}$ for the radial artery, and 1 in 10 for the ulnar. Radial varies most frequently.

With respect to the *place of origin*, the radial offered more frequent peculiarities than the ulnar, in the proportion of 13 to 8. The radial artery arose from the axillary twice as often as the ulnar. In taking origin high up from the brachial, the radial artery sprang most frequently from the upper part of that trunk; while, on the contrary, the ulnar artery most commonly arose from the brachial near the lower end.

There are certain *variations of size* presented by the radial and ulnar arteries which may be best explained together, for they exhibit a principle of compensation, according to which, if one be smaller, the other is larger. Size; compensation.

The ulnar artery is the vessel which is the most frequently diminished in size, its deficiency being then usually compensated for on the hand

by the radial, as will be shown in considering the arteries of the hand; but the palmar part of the ulnar artery may, when small, be reinforced by a large median artery, and in the fore arm the ulnar artery itself has been found to be strengthened by another branch from the anterior interosseous [plate 44, fig. 2].

Median or interosseous aids ulnar.

A diminution in size is less frequent in the radial than the ulnar artery. The defect, when it exists, is compensated, especially in the hand, by an increase in the size of the ulnar. In the fore arm the radial artery has been observed to be reinforced by the anterior interosseous in front of the wrist, and by the perforating branch of that vessel behind the carpus [op. cit. p. 321, plate 44]. The last cases referred to may be regarded as a transition to an extremely rare variety, in which the radial artery ended by giving the recurrents and a few muscular branches, the place of its descending trunk being supplied near the wrist by the interosseous. An example of this arrangement of the vessels is in the Museum of Professor Otto, at Breslau.

Small radial rare; aided by interosseous.

Absence of radial.

Branches of radial.

Branches.—The branches of the radial artery may be arranged according as they are given off in the fore arm, on the wrist, and in the hand.

In fore arm.

A. The branches which arise from the radial in the fore arm, are the radial recurrent, the muscular branches, the anterior carpal, and the superficial volar.

Recurrent.

The *radial recurrent* artery, fig. 145, *f*, which varies much in size, arches upwards from the radial soon after its origin, running between the branches of the musculo-spiral nerve. It first lies on the supinator brevis, and then on the brachialis anticus, being covered by the supinator longus. In front of the outer condyle, and in the interval between the two last muscles, it anastomoses with the terminal branches of the superior profunda [plate 42, fig. 1]. From the lower or convex side of this artery are given off several branches; one, of considerable size, to the supinator and extensor muscles, and some beneath the latter to anastomose with the posterior interosseous branches. It also supplies the supinator brevis, and brachialis anticus in part.

Muscular.

Several unnamed *muscular* branches are given to the muscles on the fore part of the arm.

Anterior carpal.

The *anterior carpal* is a small branch which arises from the radial artery near the lower border of the pronator quadratus, and runs inwards in front of the radius. It is usually called the *anterior radial carpal*, to distinguish it from a similar branch from the ulnar artery, with which it anastomoses so as to form an arch above and in front of the radio-carpal articulation, from which branches descend to supply the joints at the wrist.

Superficial volar,

The *superficial volar* [ramus superficialis volæ], *g*, proceeds

directly forwards from the radial artery, where it is about to turn backwards, following the direction of that vessel in the fore arm. In its size this branch is subject to many varieties. Most commonly it is very small, and ends in the muscles of the thumb. When it attains considerable size the artery runs over the small muscles of the thumb at their origin, lying upon the annular ligament, to which it is bound down by a thin process of fascia, and is usually described as inosculating with the radial extremity of the superficial palmar arch, which it thus completes.

varies in size; generally ends in muscles of thumb.

B. The branches which arise from the second or carpal portion of the radial artery are the following:—the posterior carpal, the metacarpal, the dorsal arteries of the thumb, and the dorsal artery of the index finger.

The *posterior carpal* (art. dorsalis carpi radialis) [plate 40, fig. 1] is small but constant. It arises opposite the carpal articulations beneath the extensor tendons of the thumb, and near the tendons of the radial extensor muscles, beneath which it runs inwards on the back of the carpus. Here it anastomoses with a similar branch from the ulnar artery, and with the termination of the anterior interosseous artery, which, it will be remembered, perforates the interosseous ligament, and becomes dorsal in the lower part of the fore arm. Branches descending from the carpal artery to the metacarpal spaces, become the *dorsal interosseous arteries* for the third and fourth interosseous spaces of the hand, after anastomosing, at the upper end of those spaces, with the posterior perforating branches from the deep palmar arch.

Posterior carpal; interosseous branches.

The *first dorsal interosseous* branch (metacarpal: ramus dorsalis interosseus primus,—Haller,) [plate 40, fig. 1,] arises beneath the extensors of the thumb, frequently with the posterior carpal branch, and descends obliquely towards the interval between the second and third metacarpal bones; it there becomes interosseous, and, after communicating with the corresponding perforating branch of the deep palmar arch, descends upon the second dorsal interosseous muscle as far as the cleft of the index and middle fingers, where it gives off dorsal superficial arteries to those fingers, and ends by communicating with the palmar digital branch at its point of division between the fingers.

First interosseous.

The *dorsal arteries* of the *thumb* (dorsales pollicis), small, and two in number, sometimes arise separately opposite the head of the metacarpal bone, and at others by a common

Dorsal arteries of thumb.

trunk which divides into two branches. They run upon the dorsal aspect of the bones of the thumb, one at the radial, the other at the ulnar border.

Dorsal of index.

The *dorsal artery* of the *index finger* (art. dorsalis indicis), a very small branch, arises lower down than the preceding, and sending branches to the abductor indicis, runs along the radial side of the back of the index finger.

Recurrent.

Peculiarities of the branches.—The radial *recurrent* is sometimes very large, or it may be represented by several separate branches. When the radial itself arises high up, the recurrent artery usually comes from the residual brachial trunk, or from the ulnar artery, or more rarely from the interosseous. When given from the brachial trunk, the radial recurrent has been found crossing beneath the tendon of the biceps.

Superficial volar;

varies in size and distribution;

The *superficial volar* branch of the radial was found to be small, in a large proportion of cases examined, 141 in 235, and to be lost in the short muscles of the thumb, without forming any connection with the palmar arch, or with any of the digital arteries. When the superficial volar had considerable size, its disposition varied as follows. In the majority of cases it simply ended in the superficial arch. In a smaller number, without joining the ulnar portion of the arch, it furnished one or more digital arteries. Lastly, the artery at the same time joined the arch and furnished one or more digital branches to the thumb and index finger [see op. cit. p. 323, and the plates there referred to].

origin and course.

The origin of the branch in question was also found to present some peculiarities. It occasionally arose from the radial at a distance of one inch and a half to two inches and a half above its ordinary position, in one case even nearly as high as the bend of the elbow. In these cases it usually descended with the radial; but when the latter turned outwards to reach the back of the limb sooner than usual, the superficial volar occupied the place of the radial in front [plate 42, figs. 3, 4, 5].

First interosseous.

Carpal defective.

The *first dorsal interosseous* branch (metacarpal), which descends on the second interosseous space to the cleft between the index and middle fingers, is not unfrequently so large as to furnish the collateral digital branch to each of those fingers [plate 46, figs. 5, 6]. The *carpal* and interosseous (metacarpal) branches of the radial are sometimes small, their place being supplied by the perforating offset of the anterior interosseous, apparently by an enlargement of the ordinary anastomosis between them [plate 44, fig. 3].

C. The branches derived from the radial after it has entered the hand, are, the great artery of the thumb, the radial branch of the index finger, and its large terminal branch, which forms the deep palmar arch [plate 39, fig. 2].

Large artery of thumb.

The *large artery of the thumb* (arteria pollicaris : art. princeps pollicis,—Haller), *h*, arises from the radial, where it is about to turn inwards across the palm of the hand. It

descends in front of the abductor indicis to the lower end of the metacarpal bone of the thumb (comes ossis metacarpi pollicis,—Haller), between the bone and the short muscles covering it, to the space between the lower ends of the short flexor of the thumb. At that point, and beneath the tendon of the long flexor, the artery divides into two branches, the collateral branches of the thumb, which course along the borders of its phalanges on their palmar aspect, and inosculate on the last phalanx, forming an arch similar in its arrangement to that on the other fingers.

The *radial branch for the index finger* (art. volaris radialis indicis,—Haller), *i*, generally arises close to the preceding branch; but though constantly found, it varies in size and in its mode of origin. It descends at first between the abductor indicis, which is behind it, and the flexor brevis and adductor pollicis in front; and continues, covered only by the skin and fascia, along the radial border of the index finger, forming the radial collateral branch (whence its name), and anastomosing in the usual manner with the ulnar collateral branch for the same finger, derived from the superficial palmar arch. This artery very frequently gives a communicating branch to the superficial arch, near the lower border of the adductor pollicis. **Radial artery of index finger.**

The most frequent method of *communication* between the radial artery and the superficial arch is by a small branch, which proceeds from the former through the muscles of the thumb. **Branch to superficial arch.**

DEEP PALMAR ARCH.

The deep palmar arch (arcus profundus volæ,—Haller) [plate 39], which is to be regarded as the palmar continuation of the radial artery, commences at the upper end of the first interosseous space between the heads of the abductor indicis, turns transversely across the palm towards the upper end of the fourth metacarpal bone, near which it inosculates with the communicating branch from the ulnar artery, and thus forms the *deep palmar arch.* The convexity of this arch is directed downwards. It is, as its name implies, more deeply seated than the superficial arch derived from the ulnar artery,—being placed upon the interosseous muscles, and the metacarpal bones, immediately below the carpal extremities of these; and being covered by the flexor brevis pollicis, the flexor tendons of the fingers, **Deep palmar arch** **inosculates with ulnar.** **Contrasted with superficial arch.**

and the muscles of the little finger. It is also higher or nearer to the carpus than the superficial arch, and differs from it in retaining its size almost undiminished. It is accompanied by the deep branch of the ulnar nerve, which runs from the inner end of the arch outwards.

Recurrent palmar;

Branches. — The *deep palmar* arch gives off *recurrent* branches (rami retrogradi,—Haller) from its upper concave side, which ascend and anastomose with the branches from the anterior carpal arch.

perforating;

It likewise furnishes *superior perforating* branches, three in number, which pass backwards through the upper extremities of the last three interosseous spaces to inosculate with the dorsal interosseous arteries.

palmar interosseous.

Lastly, the deep palmar arch affords origin from its convexity to the *palmar interosseous* arteries (interosseæ volares,—Haller), usually three in number but very liable to variation, which lie upon the interosseous spaces, supply the muscles there, and anastomose at the clefts of the fingers with the digital branches from the superficial arch. It is by an enlargement of these small vessels that the deep palmar arch sometimes supplies the corresponding digital arteries in the absence of those usually derived from the superficial arch.

ARTERIES OF THE HAND: VARIOUS CONDITIONS OF.

Two sets of arteries in hand.

The arteries of the hand frequently vary from their usual mode of distribution. Ordinarily there are, it will be remembered, two sets of arteries in the hand communicating with each other, viz. an *ulnar* or *superficial* set on the inner side, and a *radial* or *deep* set on the outer. Now, from the usual arrangement presented by these two sets of arteries there are numerous deviations, which may be classed as follows. *a.* By far the larger number of deviations consist of a deficiency in one or other of these sets of arteries, accompanied by a corresponding increase in the opposite one; and it may be observed that the defect is much more commonly on the part of the superficial and the increase on the part of the deep set. *b.* In a second and smaller class of variations a deficiency in one or other of the two systems above referred to is supplied, either by the enlargement of branches which descend in front of the limb, as the superficial volar (from the radial), or the median artery (from the anterior interosseous), or by the enlarge-

Mutually deficient and in excess.

Deficiencies supplied from other sources.

ment of a metacarpal branch (from the radial) on the back of the hand.

In illustration of these general remarks, the following modes of arrangement of the vessels may be mentioned.

In the greater number of cases the superficial palmar arch is diminished, and gives off fewer digital branches than usual. Generally only one branch is wanting, viz. that which supplies the adjacent sides of the fore and middle fingers; but sometimes two or three branches are absent, or even all four, as when the ulnar artery, after giving branches to the short muscles of the little finger, ends in the deep palmar arch. In the last-named case, which is rare, it is obvious that the superficial arch is altogether wanting. Digital branches from superficial arch defective;

These various deficiencies in the superficial palmar arch and its branches are usually compensated for by an enlargement of the deep arch, the palmar interosseous branches of which, being increased in size, divide at the clefts of the fingers, and form such collateral digital branches as are not derived from the usual source. But a defective superficial arch may, as before mentioned, be reinforced from other vessels, viz. from the superficial volar, from an enlarged median artery, or from a large metacarpal branch. furnished from deep arch.

It sometimes, but more rarely happens, that the radial system of vessels is deficient; in which case the superficial arch (which belongs to the ulnar system) may supply all the digital arteries to the thumb and fingers, or one of these may be derived from the superficial volar, the median, or the radial interosseous. [For further information on this subject, see op. citat. p. 334—7, with the illustrative figures]. Radial defective.

DESCENDING AORTA.—THORACIC AORTA.

From the point at which its arch is considered to terminate—the lower margin of the third dorsal vertebra, the aorta descends along the fore part of the spine to the fourth lumbar vertebra, where it divides into the common iliac arteries. The direction of this part of the vessel is not vertical, for as its course is influenced by the spine, upon which it rests, it is necessarily concave forwards in the dorsal region, and convex forwards in the lumbar. Again, its commencement is at the left side of the bodies of the vertebræ; its termination also inclines a little to the left, whilst about the last dorsal vertebra it is nearly upon the median line: from this arises another slight curve, the convexity of which is to the right side. Within the thorax, where the offsets are small, the aorta diminishes but little in size; in the abdomen the diminution is considerable, in consequence of large branches being furnished to the viscera in that cavity. Descending aorta; extent; direction; is doubly curved.

That part of the aorta (below the arch) which is situate in

Thoracic aorta.

the thorax is called the *thoracic aorta*, fig. 138, B [plate 47]; it extends from the lower border of the third dorsal vertebra on the left side, to the opening in the diaphragm in front of the last dorsal vertebra.

Connections.

It lies in the back part of the interpleural space (in the mediastinum), being before the spine and behind the root of the left lung and the pericardium; on the left side it is in contact with the corresponding pleura and lung, and close on the right side are the azygos vein, the thoracic duct and the œsophagus. The latter tube, however, towards the lower part of the thorax inclines in front of the artery, and near the diaphragm gets somewhat to the left side. The small azygos vein crosses behind the thoracic aorta.

Branches.

The *branches* derived from the thoracic aorta are numerous but small. They are distributed to the walls of the thorax, and to the viscera contained within it—the latter being much the smaller and least numerous branches.

The *branches to the viscera* are very irregular in their number and place of origin. They are as follows:—

Pericardiac.

The *pericardiac branches* are some very small and irregular vessels which pass forwards and ramify on the pericardium.

Bronchial,

The *bronchial* arteries are the proper nutritious arteries of the substance of the lung: they accompany the bronchial tubes in their ramifications through that organ, and they also supply the bronchial glands, and in part the œsophagus.

vary much.

These vessels vary frequently in number, and in their mode of origin. The bronchial artery of the right side arises from the first aortic intercostal artery, or by a common trunk with the left bronchial artery from the thoracic aorta; on the left side there are generally two bronchial arteries, both of which arise from the thoracic aorta, one near the commencement of that trunk, and the other, named inferior bronchial, lower down. Each artery is usually directed to the back part of the corresponding bronchus, along which it runs, dividing and subdividing with the successive bronchial ramifications in the substance of the lung.

Peculiarities of bronchial arteries in origin.

Peculiarities of the bronchial arteries.—The place of origin is liable to much variation.

The artery of the right side has been found to arise singly from the aorta, from the internal mammary, or from the inferior thyroid. The bronchial arteries of the two sides have been seen to arise by a common trunk from the subclavian (Haller). Two such common trunks, each furnishing a branch to the right and left lungs, have been observed in a single case to descend into the thorax after arising, one from the internal mammary, and the other from the superior

intercostal artery [plate 24, fig. 5]. Some other peculiarities in these arteries of less note have from time to time been recorded; it is necessary only to refer to one, viz. the occurrence of two distinct bronchial arteries for each lung. in number.

The *œsophageal* arteries are variable in size and number; there are usually four or five, which arise from the fore part or right side of the aorta, and run obliquely downwards upon the œsophagus, supplying its coats. The lower branches of these vessels anastomose with the ascending offsets of the coronary artery of the stomach, whilst the upper branches communicate in a similar way with those of the inferior thyroid artery. Œsophageal.

The glands and loose tissue in the posterior mediastinum also receive small branches (*posterior mediastinal*). Mediastinal.

The *branches* furnished by the aorta *to the walls of the thorax* are named intercostal from their course between the ribs.

The *intercostal* arteries, fig. 138, *f, f* (*inferior* or *aortic intercostals*) [plate 48], arise from the posterior part of the aorta, and run outwards upon the bodies of the vertebræ, after which they lie along the intercostal spaces. They are usually ten in number,—the upper intercostal space, and occasionally also a second space, being supplied by the superior intercostal (a branch of the subclavian artery). Owing to the position of the aorta to the left side of the spine, the right aortic intercostals cross over the front of the vertebræ, furnishing many small branches to those bones; and they are therefore a little longer than the arteries of the left side. As these vessels pass outwards they are covered by the pleura, and crossed by the sympathetic nerve; those of the right side also pass behind the œsophagus, the thoracic duct, and the azygos vein [plate 47]. Intercostal, number; longer on right side.

Having reached the end of its corresponding intercostal space, each aortic intercostal artery divides into two branches, of which one (a *dorsal branch*) passes backwards and will be presently described; whilst the other or *anterior* part continues outwards between the ribs. Each divides into two branches.

This *anterior* branch, or proper *intercostal* artery, passes outwards at first between the pleura with a thin fascia in front, and the external intercostal muscle behind; and afterwards between the two layers of intercostal muscles. Having gained the lower border of the rib above, near the angle of the bone, by passing obliquely upwards from the middle of the intercostal space, the artery furnishes several Anterior branch

small branches, and one long and slender branch which inclines downward and approaches the border of the rib below, supplying the bone and the intercostal muscles. After giving off these branches, the artery continues along the lower border of the rib above, and supplying then the intercostal muscles, anastomoses with the anterior intercostal branches derived from the internal mammary artery, and with the thoracic branches of the axillary artery.

Joins with anterior intercostals.

The first of the aortic intercostal arteries has an anastomosis with the superior intercostal, which is derived from the subclavian artery; and the last three are prolonged amongst the abdominal muscles, where they communicate with the epigastric artery in front, with the phrenic arteries at the side, and with the lumbar branches of the abdominal aorta lower down.

Each intercostal artery is accompanied, as it runs outwards between the ribs, by a corresponding vein, and by one of the dorsal nerves.

Dorsal branch;

The *posterior or dorsal* branch of each intercostal artery passes backwards to the inner side of the anterior costo-transverse ligament, with the posterior branch of the corresponding spinal nerve; and having furnished an offset to the spinal canal, reaches the muscles of the back, and divides into an internal and an external branch. The internal branch is directed towards the spinous processes, on or through the multifidus spinæ and ramifies in the muscles and the skin. The external branch turns outwards under the longissimus dorsi, and is distributed between that muscle and the sacro-lumbalis; some reach the superficial muscles and the teguments [plate 19].

supplies deep muscles of back;

and spinal canal.

The *spinal* branches of the aortic intercostal arteries are distributed partly to the cord and its membranes, and partly to the bones, in the same manner as the spinal branches of the lumbar arteries, to the description of which reference is to be made.

ABDOMINAL AORTA.

Abdominal aorta;

The aorta, after having passed the diaphragm, is thus named. It rests on the vertebræ of the loins, extending from the front of the last dorsal to the fourth lumbar vertebra, a little to the left of the median line, where it usually divides. The anterior surface of the great artery is successively in apposition with the pancreas and the splenic

extent;

parts in contact.

vein, the left renal vein, the third portion of the duodenum, and the peritoneum. The vena cava lies at its right side, the right crus of the diaphragm being interposed at the upper part of the abdomen; close to the same side are the thoracic duct and the ázygos vein, which are placed between the aorta and the right crus of the diaphragm. The aorta is covered in front by a mesh of nerves derived from the sympathetic.

The abdominal aorta, fig. 138, c [plates 53, 54], gives numerous *branches*, which may be divided into two sets, viz., those which supply the viscera, and those which are distributed to the walls of the abdomen. The former consists of the cœliac artery, the superior mesenteric, the inferior mesenteric, the capsular, the renal, and the spermatic arteries; whilst in the latter are included the phrenic, the lumbar, and the middle sacral arteries. The three first of the visceral branches are single arteries. Branches; two series.

CŒLIAC ARTERY OR AXIS.

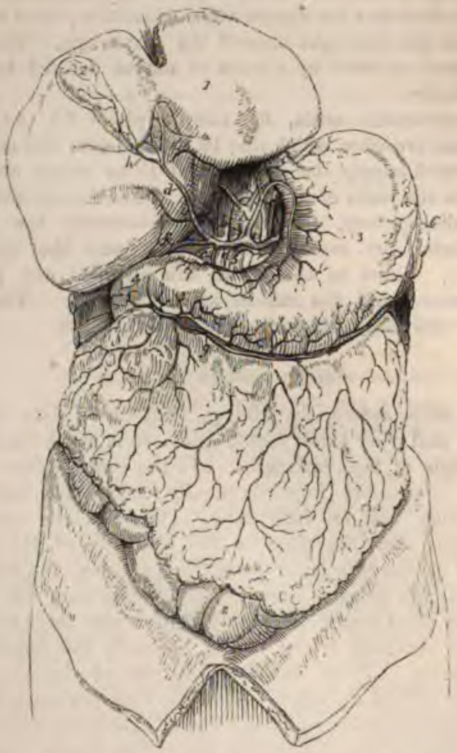
The *cœliac artery*, fig. 138, *g*, fig. 146, *b* [plates 49, 53], a short and very thick vessel, arises from the aorta close to the margin of the diaphragm. In the erect position of the body it is directed forwards nearly horizontally, and is not more than half an inch long. It is behind the small omentum, and lies close to the left side of the lobulus Spigelii of the liver, and above the pancreas, the two semilunar ganglia being contiguous to it, one on each side. After this very short course, the artery divides into three branches, viz., the coronary artery of the stomach, the hepatic, and the splenic. These branches separate at the same time from the end of the artery like radii from an axis, whence, says Winslow, this trunk has been called axis arteriæ cœliacæ. Cœliac artery. Is very short; its connections. Branches; three visceral;

Besides the branches which supply the viscera, the cœliac usually gives off one branch to the walls of the abdomen, viz., one of the phrenic arteries. one phrenic.

The *cœliac axis* is from time to time partly covered at its origin by the diaphragm. It may be longer than usual, in which case its branches are not given off together [plate 56, fig. 4]; or it may be wanting altogether, the coronary, hepatic, and splenic arteries arising separately from the aorta [plate 57, fig. 3]. In some cases the cœliac artery gives off only two branches at its division (the coronary and the splenic), the hepatic being supplied from another source. Rarely, it gives more than three branches to the viscera, the additional vessel being a second coronary, or a separate gastro-duodenal artery. Both phrenic arteries are sometimes derived from this trunk. Cases have been met with in Various states of cœliac.

which a connection existed between the cœliac axis and the superior mesenteric artery close to their origin.

Fig. 146.*



CORONARY ARTERY OF THE STOMACH.

Coronary artery of stomach.

The coronary artery of the stomach (coronaria ventriculi), fig. 146, c [plate 49], the smallest of the three visceral branches

* The viscera of the upper part of the abdomen, with the cœliac artery and its branches, are represented in this sketch. 1 Liver. 2. Gall-bladder. 3. Stomach. 4. Its pyloric end. 5. Pancreas. 6. Spleen. 7. Great omentum. A. Aorta. *a*. Phrenic arteries. *b*. Cœliac. *c*. Coronary of stomach. *d*. Hepatic. *e*. Pyloric. *f*. Gastro-duodenal. *g*. Right gastro-epiploic. *h*. Cystic artery to gall-bladder. *i*. Splenic. *k*. Left gastro-epiploic.

derived from the cœliac artery, inclines upwards, and to the left side, to reach the cardiac orifice of the stomach. At this point some branches are sent upwards on the œsophagus, which communicate with the aortic œsophageal arteries; others pass before and behind the cardiac extremity of the stomach, and join with branches of the splenic artery. The continuation of the vessel lies between the layers of the smaller omentum, and inclining from left to right along the upper curvature of the stomach, gives branches to that viscus, and inosculates with the pyloric branch of the hepatic artery.

The coronary artery of the stomach is sometimes given off directly from the aorta [plate 57, fig. 3]; and is occasionally represented by two separate vessels. It sometimes furnishes an additional hepatic artery. Different states of.

HEPATIC ARTERY.

The hepatic artery, fig. 146, *d* [plates, 49, 50], which is intermediate in size, at least in the adult, between the coronary and splenic arteries, gives branches to the stomach, the duodenum, and the pancreas, besides supplying the liver and gall-bladder. It inclines upwards and to the right side, between the layers of the small omentum, and in front of the foramen of Winslow, to reach the transverse fissure of the liver, in which course it lies upon the vena portæ and to the left of the bile-duct. Previously to reaching the liver, it gives the following *branches:* Hepatic artery; course and connections; branches.

The *pyloric* artery, *e*, descends to reach the pyloric end of the stomach, turning from right to left along the upper curvature, supplies that organ with branches, and inosculates with the coronary artery. This is sometimes a branch of the following artery (the gastro-duodenal). Pyloric;

The *gastro-duodenal*, *f*, descends behind the duodenum near the pylorus, and on reaching the lower border of the stomach, changes both its name and direction. It runs from right to left along the great curvature of the stomach, between the layers of the great omentum, assuming the name of *right gastro-epiploic*, *g*, and inosculates with the left gastro-epiploic derived from the splenic artery. This artery gives branches upwards to both surfaces of the stomach, and long slender vessels downwards to the omentum. From the gastro-duodenal artery a branch, *pancreatico-duodenal*, fig. 147, *g*, descends along the inner margin of the duodenum, gastro-duodenal; gastro-epiploic; pancreatico-duodenal.

between this and the pancreas, and, after furnishing several branches to both these organs, anastomoses with a small offset of the superior mesenteric artery.

Hepatic divides into left

Near the transverse fissure of the liver, the hepatic artery divides into its right and left branches, which are intended for the supply of the corresponding lobes of that organ. The *left*, the smaller division, lying in front of the vena portæ, diverges at an acute angle from the other branch, and turns outwards to reach the left extremity of the transverse fissure of the liver, where it enters that organ.

and right branches;

latter gives off cystic.

The *right hepatic* artery inclines outwards to the right extremity of the transverse fissure. When crossing behind the cystic duct, it gives off a branch, *h*, the *cystic* artery, which turns upwards and forwards upon the neck of the gall-bladder, and divides into two smaller branches, of which one ramifies between the coats at the depending surface, the other between the bladder and the liver. The right hepatic artery then divides into two or three branches, which enter the liver by the transverse fissure, and ramify in its substance, accompanying the divisions of the vena portæ and hepatic ducts.

Varieties of hepatic.

The hepatic artery may arise from the superior mesenteric artery [plate 56, fig. 6], or from the aorta itself [plate 57, fig. 3]. Accessory hepatic arteries are often met with, usually coming from the coronary artery of the stomach. It has been found to furnish a phrenic branch [plate 56, fig. 6].

SPLENIC ARTERY.

Splenic artery;

course is tortuous.

The splenic artery, figs. 146, 147, *i* [plates 49, 50], in the adult the largest branch of the cœliac artery, is destined to supply the spleen, and in part the stomach and pancreas. It is directed horizontally towards the left side. Waving and often tortuous in its course, it passes, together with the splenic vein which is below it, behind the upper border of the pancreas, and divides near the spleen into several branches. Some of these enter the fissure in that organ, and are distributed to its substance; three or four are reflected towards the bulging end of the stomach, upon which they ramify.

Its branches; pancreatic;

Its *branches* to the viscera are the following:

The *pancreatic* branches, fig. 147, *k*, variable in size and number, are given off whilst the artery is passing along the pancreas, the middle and left part of which they supply

with vessels. One of larger size not unfrequently runs from left to right, in the direction of the pancreatic duct, and is called *pancreatica magna*. One of these is larger.

Fig. 147.*

The *splenic* branches are the proper terminal branches of the artery; they are five or six, or even more, in number, and vary in length and size; they enter the spleen by the hilus or fissure in its concave surface, and ramify within that organ. Splenic.

The *gastric* branches, *l*, (*vasa brevia*), vary from five to seven in number; they are directed from left to right, some issuing from the trunk of the splenic artery, others from its terminal branches: they reach the left extremity of the stomach, where they divide and spread out between the coats, communicating with the coronary and left gastro-epiploic arteries. Gastric or vasa brevia.

The left *gastro-epiploic* artery runs from left to right along the great curvature of the stomach, fig. 147, *m*, Left gastro-epiploic.

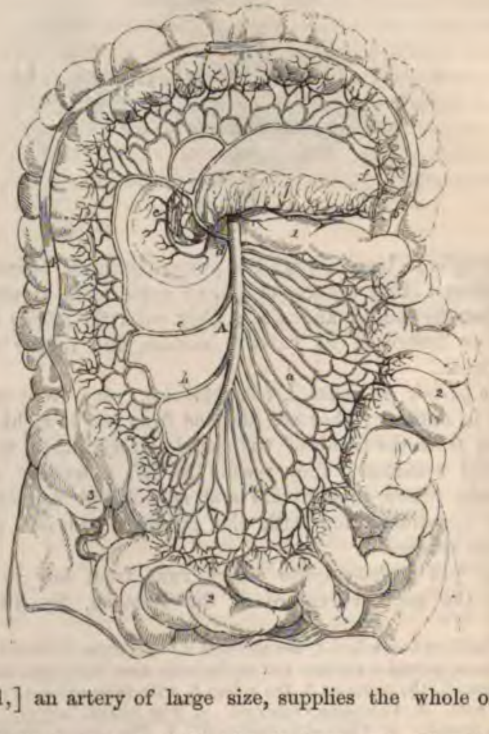
* The liver is marked 1, the stomach 2; this organ is drawn up so as to show its under surface, and at the same time bring into view the duodenum 3, the pancreas 4, the spleen 5, with their arteries. *a*. The cœliac axis. *b*. Coronaria ventriculi. *c*. The hepatic artery. *d*. Its pyloric branch. *e*. The gastro-duodenal. *f*. The right gastro-epiploic. *g*. The pancreatico-duodenal. *h*. The cystic. *i*. The splenic artery. *k*. Its pancreatic branches. *l*. The vasa brevia. *m*. The left gastro-epiploic. *n*. The superior mesenteric artery. A. The trunk of the aorta cut off below the transverse part of the duodenum.

fig. 146, *k*, and inosculates with the right gastro-epiploic branch from the hepatic artery. In its course, this vessel lies between the layers of the peritoneum at the great border of the stomach; it gives several long and slender branches downwards to the omentum, and others upwards to both surfaces of the stomach, where they communicate with the other gastric arteries.

SUPERIOR MESENTERIC ARTERY.

Superior mesenteric; The superior mesenteric, fig. 147, *n*; fig. 148, A, [plates

Fig. 148.*



50, 51,] an artery of large size, supplies the whole of the

* The transverse part of the colon is drawn up; and one layer of the mesentery, and one of the transverse meso-colon, as well as the single layer connected with the colic arteries of the right side, are removed to lay the arteries bare:—1. is the termination of the duo-

small intestine beyond the duodenum, and half of the great intestine. It arises from the fore part of the aorta, a little below the cœliac artery. For a short space this artery is covered by the pancreas; on emerging from below that gland it descends in front of the duodenum near the end, and is thence continued between the layers of the mesentery. The splenic vein crosses over its root. In the mesentery the artery at first passes downwards and to the left side, but afterwards curves towards the right iliac fossa, opposite to which it inosculates with its own ileo-colic branch.

origin; connections; curves to right side.

Branches.—Whilst under cover of the pancreas, the superior mesenteric artery sends off a small branch, *inferior pancreatico-duodenal*, fig. 148, *e*, which runs along the concave border of the duodenum, and joins with the pancreatico-duodenal artery. Its other branches may be divided into two sets, viz., those from the left or convex, and those from the right or concave side.

Branches; one to pancreas and duodenum

Those which spring from the convex or left side of the vessel, fig. 148, *a*, *a*, (*rami intestini tenuis*,) are intended for the supply of the jejunum and ileum. They are usually twelve or more in number, and are all included between the layers of the mesentery. They run parallel to one another for some distance, and then divide into two branches, each of which forms an arch with the neighbouring branch. From the first set of arches other branches issue, which divide, and recommunicate in the same way, until finally, after forming four or five such tiers of arches, each smaller than the other, the ultimate divisions of the vessels proceed directly to the intestine, turning upon it on both sides, and ramifying in its coats.

from convexity, to small intestines;

The branches from the right or concave side of the superior mesenteric artery are given to the colon, and hence are named the *colic* arteries.

from concavity to colon.

The *ileo-colic* artery, *b*, the first in order from below upwards, inclines downwards and to the right side, towards the ileo-colic valve, near which it divides into two branches: one of these descends to inosculate with the termination of the mesenteric artery itself, and to form an arch, from the convexity of which branches proceed to supply the junction of the small with the large intestine, and the

Ileo-colic.

denum. 2, 2. The convolutions of the small intestines. 3. The cæcum. 4, 5, 6. The ascending, transverse, and descending colon. 7. The pancreas.—Arteries. A. Superior mesenteric. *a* to *e*. Its several branches.

cæcum and its appendix; the other division ascends and inosculates with the following branch.

Right colic. The *right colic* artery, *c*, passes transversely towards the right side, beneath the peritoneum, to the middle of the ascending colon, opposite to which it resolves itself into two branches, of which one descends to communicate with the ileo-colic artery, whilst the other ascends to join in an arch with the middle colic. This artery and the ileo-colic often arise by a common trunk.

Middle colic. The *middle colic* artery, *d*, passes upwards between the layers of the meso-colon towards the transverse colon, and divides in a manner exactly similar to that of the vessels just noticed. One of its branches inclines to the right, where it inosculates with the preceding vessel; the other descends to the left side, and maintains a similar communication with the left colic branch, *f*, derived from the inferior mesenteric artery. From the arches of inosculation thus formed, small branches pass to the colon for the supply of its coats. Those branches of the superior mesenteric artery which supply the ascending colon have a layer of peritoneum only on their anterior aspect: the others lie between two strata.

Peculiarities. The superior mesenteric artery is occasionally connected at its origin with the cœliac artery. Not unfrequently it furnishes the hepatic artery [plate 56, fig. 6].

INFERIOR MESENTERIC ARTERY.

Inferior mesenteric; This artery, fig. 137, *i*; fig. 149, *d*, [plate 52,] much smaller than the superior mesenteric, supplies the left side of the colon, and the greater part of the rectum. It arises from the aorta, between an inch and two inches above the bifurcation of that trunk.

course; The inferior mesenteric artery deviates to the left side in the direction of the left iliac fossa, from which point it descends between the layers of the meso-rectum into the pelvis, and under the name of "superior hæmorrhoidal" artery, runs down behind the rectum. It lies at first close to the aorta, on its left side, and then crosses over the left common iliac artery.

connections.

Branches. The *branches* are the following:

Left colic. The *left colic* artery (colica sinistra), fig. 149, *e*, is directed to the left side behind the peritoneum, and across the left kidney to reach the descending colon. It divides into two

branches, and forms a series of arches in the same way as the colic vessels of the opposite side. One of these two

Fig. 149.*

branches passes upwards along the colon, and inosculates with the descending branch of the middle colic; whilst the other descends towards the sigmoid flexure, and anastomoses with the sigmoid artery.

The *sigmoid* artery, *f*, runs obliquely downwards to the sigmoid flexure of the colon, where it divides into branches; some of which incline upwards and form arches with the preceding vessel, others turn downwards to the rectum and anastomose with the following branch. Instead of a single sigmoid artery, two or three branches are sometimes present. Sigmoid.

* The descending colon and its arteries. 1. Transverse colon. 2. Descending colon. 3. Sigmoid flexure of colon. 4. Rectum. 5. Small intestines. 6. Pancreas. A. Aorta. *a*. Superior mesenteric artery. *c*. Middle colic artery. *d*. Inferior mesenteric. *e*. Left colic. *f*. Sigmoid. *g*. Superior hæmorrhoidal.

Superior hæmo-rrhoidal.

The *superior hæmorrhoidal* artery, *g* (hæmorrhoidalis interna,—Haller), the continuation of the inferior mesenteric, passes into the pelvis behind the rectum, at first in the peritoneal fold—the meso-rectum, and then divides into two branches which extend one on each side of the intestine towards the lower end. About five inches from the anus these subdivide into branches, about a line in diameter, that pierce the muscular coat two inches lower down. In the intestine, about seven in number and placed at regular distances from each other, these arteries descend between the mucous and muscular coats to the end of the gut, where they communicate in loops opposite the internal sphincter, and end below by anastomosing with the middle and inferior hæmorrhoidal arteries [plates 59, 60].

Ending on the gut.

Anastomoses of arteries along alimentary canal.

Anastomoses on the intestinal tube.—In this place it may be remarked that the arteries distributed to the alimentary canal communicate freely with each other over the whole length of that tube. The arteries of the great intestine derived from the two mesenteric arteries, form a range of vascular arches along the colon and rectum, at the lower end of which they anastomose with the middle and inferior hæmorrhoidal arteries, given from the internal iliac and pudic arteries. The branches from the left side of the superior mesenteric form another series of arches along the small intestine, which is connected with the former by the ileo-colic artery. Farther, a branch of the superior mesenteric joins upon the duodenum with the pancreatico-duodenal artery. The latter, at its commencement, is in a manner continuous with the pyloric artery ; and so likewise, through the coronary artery of the stomach and its ascending branches, a similar connection is formed with the œsophageal arteries, even up to the pharynx.

CAPSULAR OR SUPRARENAL ARTERIES.

Supra-renal artery;

The suprarenal or capsular arteries, fig. 138, *m*, [plate 54], are two very small vessels which arise from the aorta on a level with the superior mesenteric artery, and incline obliquely outwards upon the crura of the diaphragm to reach the under surface of the suprarenal capsules, to which bodies they are distributed, anastomosing at the same time with the other capsular branches derived from the phrenic and the renal arteries. In the fœtus these arteries are of large size.

is large in fœtus.

RENAL OR EMULGENT ARTERIES.

The renal arteries, fig. 138, *n*, [plates 53, 54,] of large diameter in proportion to the size of the organs which they supply, arise from the sides of the aorta, about half an inch below the superior mesenteric artery, that of the right side being rather lower down than that of the left. Each is directed outwards, so as to form nearly a right angle with the aorta. In consequence of the position of the aorta upon the spine, the right renal artery has to run a somewhat longer course than the left, in order to reach the right kidney. The artery of the right side crosses behind the vena cava, and both are overlapped by the accompanying renal vein. Previously to reaching the concave border of the kidney, each artery divides into four or five branches, the greater number of which usually lie intermediate between the vein in front, and the upper part of the ureter behind. These branches, after having passed deeply into the fissure of the kidney, subdivide and are distributed in the gland, in the manner described in the account of the structure of that organ.

Renal arteries.

Direction transverse;

the right is the longer;

enters fissure of kidney.

Branches.—The renal artery furnishes a small branch to the suprarenal capsule, another which ramifies in the connective tissue and fat behind the kidney, and a third to the ureter.

Branches.

Peculiarities.—The *renal* artery may be represented by two, three, four, or even five branches; and the greatest difference is found to exist even on opposite sides of the same body, as to the origin of these accessory vessels [plate 57, various figures]. As they usually arise in succession from the aorta itself, it would seem as if the deviation is merely a step beyond that in which the single artery divides into branches sooner than usual after its origin [plates 54, 56, fig. 5]. In some cases a renal artery has been seen to proceed from the common iliac [plate 57, figs. 3, 4]; and in one case, described by Eustachius, from the internal iliac. Portal found in one instance the right and left renal arteries arising by a common trunk from the fore part of the aorta. In another case, one of several arteries arose from the front of the aorta at its bifurcation; or from the left common iliac at its origin [plate 57, fig. 3].

More than one artery.

Varieties in origin.

The branches of the renal artery, instead of entering at the hilus, may reach and penetrate the gland near its upper end, or on its anterior surface [plate 57, fig. 3]. Lastly, cases occur, though very rarely, in which one of the renal arteries is wanting.

Branches enter kidney irregularly.

SPERMATIC AND OVARIAN ARTERIES.

Spermatic arteries, slender and long; The spermatic arteries, fig. 138, *o*, [plates 53, 55,] two small and very long vessels, arise from the fore part of the aorta a little below the renal arteries. In the fœtus they are short, as the testes at an early period of development are placed immediately beneath the kidneys; but the arteries become gradually lengthened as those organs are moved from the abdomen into the scrotum. Each spermatic artery is first directed outwards and downwards, crossing the ureter, and resting on the psoas muscle; after passing over the external iliac artery, it turns forwards to the internal abdominal ring, where it comes into contact with the vas deferens. With this and the other constituents of the spermatic cord the artery courses along the inguinal canal, and descends to the scrotum to be finally distributed to the testis, after reaching the back part of that gland and anastomosing there with the artery of the vas deferens. The spermatic arteries are covered by the peritoneum until they reach the internal ring. Near the testis they become tortuous.

(Margin notes: in abdomen; in spermatic cord.)

Artery in female. Ovarian. In the female, the arteries corresponding to the spermatic arteries in the male, named the *ovarian* [plate 59], are shorter than those vessels, and do not pass out of the abdominal cavity. Their origin, direction, and connections in the first part of their course, conform to what obtains in the male; but at the margin of the pelvis they incline inwards, and running tortuously between the layers of the broad ligaments of the uterus, are guided to the attached margin of the ovaries, which they supply with branches. Some small offsets can be also traced along the round ligament into the inguinal canal, and others along the Fallopian tubes: one, continuing inwards towards the uterus, joins with the uterine artery [plate 63, fig. 1].

Various states. The *spermatic* arteries occasionally arise by a common trunk. Two spermatic arteries are not unfrequently met with on one side; both of which usually arise from the aorta, though one may be a branch from the renal artery. A case has occurred of three arteries on one side,—two from the aorta and the third from the renal [plate 57, fig. 5].

INFERIOR PHRENIC ARTERIES.

Phrenic [illegible] The phrenic arteries, fig. 146, *a*, [plates 53, 54,] are

two small vessels, which arise from the aorta on a level with the under surface of the diaphragm. These little arteries are very irregular in their origin. Supposing them to arise separately from each other, which is by no means a constant arrangement, one is derived most commonly from the cœliac artery close to the origin, and the other from the aorta on a level with the under surface of the diaphragm. They soon diverge from each other, and passing across the crura of the diaphragm, incline upwards and outwards upon its under surface. The artery of the left side, having passed behind the œsophagus, ascends on the left of the œsophageal opening of the diaphragm; whilst the right phrenic artery, after having passed behind the liver and the vena cava, lies to the right side of the opening in the diaphragm which transmits that great vein. Before reaching the central tendon of the diaphragm, each of the arteries divides into two branches, of which one runs forwards towards the anterior margin of the thorax, distributing branches to the diaphragm, and finally anastomosing with the musculo-phrenic branch of the internal mammary artery. The other pursues a transverse direction towards the side of the thorax, and communicates with the terminations of the intercostal arteries.

origin variable; course. Branches; to diaphragm;

Each phrenic artery gives small branches (superior capsular) to the suprarenal capsule of its own side; the left artery sends some branches to the œsophagus, whilst the artery of the right side gives small vessels, which reach the termination of the vena cava. Small offsets descend to the liver between the layers of the peritoneum.

to suprarenal body.

The *phrenic* arteries are found to vary greatly in their mode of origin, but these deviations seem to have little influence on their course and distribution. In the first place, they may arise either separately, or by a common trunk: and it would appear that the latter mode of origin is nearly as frequent as the former.

Various origin:

When the two arteries are joined at their origin, the common trunk arises most frequently from the aorta [plate 56, fig. 4]; though, sometimes, it springs from the cœliac axis [plate 56, fig. 6].

as a common trunk,

When arising separately, the phrenic arteries are given off sometimes from the aorta [plate 54], more frequently from the cœliac axis [plate 53], and occasionally from the renal [plate 56, fig. 5]; but it most commonly happens that the artery of the right side is derived from one, and that of the left side from another of these sources. An additional phrenic artery (derived from the left hepatic) has been once met with [plate 56, fig. 6].

or separately.

In only one out of thirty six cases did the phrenic arteries arise in the mode ordinarily described; viz., as two separate vessels from the abdominal aorta [op. cit. p. 417].

LUMBAR ARTERIES.

Lumbar arteries; resemble intercostal.

The lumbar arteries, fig. 138, *p*, resemble the intercostal arteries, not only in their mode of origin, direction, and size, but also in a great measure in the manner of their distribution. Thus, as the intercostal arteries communicate with the branches of the internal mammary upon the thorax, so the lumbar arteries, by anastomosing with the epigastric, have a nearly similar relation to the walls of the abdomen.

four or five in number;

The lumbar arteries arising from the back part of the aorta are usually four in number on each side. They pass outwards (each crossing the middle of the body of the corresponding lumbar vertebra), and soon dip deeply under the psoas muscle, between it and the bodies of the vertebræ [plates 53, 54]. The two upper arteries are likewise under the pillars of the diaphragm; and those on the right side are covered by the vena cava. At the interval between the transverse processes, each lumbar artery divides into a *dorsal* and an *abdominal* branch.

divide into two branches.

Abdominal branch;

The *abdominal* branch of each lumbar artery runs outwards behind the quadratus lumborum,—the lowest of these branches not unfrequently in front of that muscle. Continuing outwards between the abdominal muscles, the artery ramifies within them, and maintains communications with branches of the epigastric and internal mammary in front, with the terminal branches of the intercostals above, and with those of the ilio-lumbar and circumflex iliac arteries below.

dorsal branch supplies muscles of the back;

The *dorsal* branch of each lumbar artery, like the corresponding branch of the intercostal arteries, gives off, immediately after its origin, an offset, named *spinal*, which enters the spinal canal. The dorsal branch then, proceeding backwards with the posterior primary branch of the corresponding lumbar nerve between the transverse processes of the vertebræ, divides into smaller vessels, which are distributed to the muscles and the integument of the back.

and gives a branch to spinal canal;

The *spinal artery* enters the spinal canal through the intervertebral foramen, and, having given an offset which runs along the nerves to the dura mater and cauda equina and communicates with the other spinal arteries, divides into two branches, which are distributed to the bones in

its distribution:

the following manner:—one curves upwards on the back

part of the body of the vertebra above, near to the root of the pedicle, whilst the other descends in a similar manner on the vertebra below; and each communicates with a corresponding branch from the neighbouring spinal artery. As this arrangement prevails on both sides and throughout the whole length of the spine, there is formed a double series of arterial arches behind the bodies of the vertebræ, the convexities of which are turned towards each other. From the arches on opposite sides offsets are directed inwards at intervals to reinforce a median longitudinal vessel, which extends along the spine like the single artery on the front of the spinal cord. The arches are moreover joined together across the bodies of the vertebræ by transverse branches.

by loops, and by

a median and transverse branches.

From this interlacement of vessels, numerous ramifications are distributed to the periosteum and the bones [plate 87, fig. 3].

The *lumbar* arteries of opposite sides, instead of taking their origin separately from the aorta, occasionally commence by a common trunk, whose branches pass out laterally, and continue their course in the ordinary way. Two arteries of the same side are sometimes conjoined at their origin. On the last lumbar vertebra, the place of a lumbar artery is often taken by an offset from the middle sacral artery, and the ilio-lumbar compensates for the absence of the lumbar vessel amongst the muscles.

Varieties in lumbar arteries.

MIDDLE SACRAL ARTERY.

The middle sacral artery, fig. 138, *k*, the last of the branches of the abdominal aorta, is a small vessel about the size of a crowquill, which arises from the extremity of the aorta just at the bifurcation. From this point the artery proceeds downwards upon the last lumbar vertebra and over the middle of the sacrum, as far as the coccyx, where it forms small arches of anastomosis with the lateral sacral arteries. From its anterior surface some small branches come forwards within the fold of the meso-rectum, and ramify upon the posterior surface of the intestine; and on each side others spread out upon the sacrum, and anastomose with the lateral sacral arteries, occasionally sending small offsets into the anterior sacral foramina [plate 54].

Middle sacral is continuation of aorta along vertebræ.

The middle sacral artery sometimes deviates a little to the side, and proceeds, not from the bifurcation of the aorta, but from one of the common iliac arteries, usually from that of the left side. This artery represents the caudal prolongation of the aorta of animals.

Varies in origin.

UNUSUAL PULMONARY BRANCH FROM THE ABDOMINAL AORTA.

Unusual pulmonary artery.

A very remarkable case is recorded of the existence of a large pulmonary branch which arose from the abdominal aorta, close to the cœliac artery, and after passing upwards through the œsophageal opening in the diaphragm, divided into two branches, which were distributed to the lungs, near their bases.*

BIFURCATION ON THE AORTA.

Bifurcation of aorta; place of.

The abdominal aorta ends by dividing into two trunks, named the common iliac arteries. The bifurcation usually takes place on the body of the fourth lumbar vertebra, a little to the left of the middle line. The point here indicated will be found nearly on a level with a line drawn from the one crista ilii to the other, and is opposite the left side of the umbilicus. It should however be observed, that the place of division is very inconstant in its position, as will be seen from the following statement:

Variations.

Variations.—In more than three fourths of a considerable number of cases, the aorta divided either upon the fourth lumbar vertebra, or upon the intervertebral disc below it; in one case in nine it was below, and in about one in eleven above the spot thus indicated.—In ten bodies out of every thirteen, the division of the great artery took place within half an inch above or below the level of the iliac crest; and it occurred more frequently below than above the intervertebral space mentioned [op. cit. p. 415].

The highest point at which the bifurcation of the aorta has been seen to take place, is immediately after the origin of the right renal artery. In this case (only one is recorded) the two parts resulting from the division of the vessel were connected by a transverse branch, and then divided each into the external and internal iliac arteries.†

COMMON ILIAC ARTERIES.

Common iliac arteries;

The common iliac arteries, fig. 138, *q*, [plate 53,] com-

* Description d'un artère pulmonaire, &c., par A. Maugars d'Angers, Journal de Médecine, Chirurgie, Pharm., &c., par les Citoyens Corvisart, Leroux, et Boyer. Paris: An. 10. Also, "The Arteries," by R. Quain, p. 426.

† Sylloge observ. anatom. select., § 77, in Haller. "Disputat. Anatom." t. vi. p. 781. "The Arteries," by R. Quain, p. 416.

mencing at the bifurcation of the aorta, pass downwards and outwards, diverging from each other, and divide opposite the intervertebral substance between the last lumbar vertebra and the sacrum into two branches, named the internal and external iliac arteries—the former being distributed to the walls and viscera of the pelvis, whilst the latter is prolonged into the lower limb, after having sent two important branches to the walls of the abdomen. extent; division;

The common iliac arteries measure usually about two inches in length. Both are covered by the peritoneum and the intestines, and are crossed by the ureters at their point of division, as well as by the branches of the sympathetic nerve which are directed towards the hypogastric plexus. They rest on the bodies of the vertebræ, approaching respectively the psoas muscles at their ends. usual length.

The commom iliac arteries of opposite sides differ in some degree in their connections with other parts, but more especially with the neighbouring veins. Thus, the artery of the right side is placed at a distance from the front of the last lumbar vertebra, the two common iliac veins being interposed. The artery of the left side is crossed by the branches of the inferior mesenteric vessels. Difference in connections on two sides.

Veins.—The left iliac vein, supported on the last lumbar vertebra, lies to the inner side of, and below the left artery. On the right side there are three veins in connection with the artery; the right iliac vein lying behind the lower part of the vessel, the iliac vein of the left side crossing behind it, and the vena cava resulting from the union of the two others being on the right side of the artery at the upper end [plate 55]. Veins.

No collateral branch that has received a name is given off by the common iliac artery in its course; but somewhat above the sacro-iliac symphysis, as has been observed, each divides into two branches, the internal and external iliac arteries. Of these the internal iliac artery, which furnishes branches to supply the pelvis, the pelvic viscera, and the perinæum, will be first described. Terminal branches.

Peculiarities.—Besides slight differences between the arteries of the two sides in length and direction, by no means of constant occurrence, the common iliac arteries vary in their place of origin, and in the point at which they divide. Various conditions.

The place of *origin* of the common iliac arteries coincides with that of the bifurcation of the aorta, the variations in which have been already noticed. Origin.

Division. The *height* at which these arteries *divide* is subject to great variety. In two thirds of a large number of cases, the place of division ranged between the middle of the last lumbar vertebra and the upper margin of the sacrum; in one case in eight it was above, and in one case in six below that space. Most frequently the left artery was found to divide lower down than the right.

Length. The *length* was observed also to differ much in different instances. In five sevenths of the cases examined, it varied from an inch and a half to three inches; of the remaining cases, in about half, the artery was longer, and in the other half, shorter; the minimum length being (only in one case) less than half an inch [plate 57, fig. 8], and the maximum four inches and a half [plate 58, fig. 1]. In estimating the relative lengths of the right and left arteries, it was found that the right was the longer in sixty three, and the left in fifty two, whilst the two were equal in fifty three [op. cit. p. 433-6].

Absence very rare. In one instance, recorded by Cruveilhier, ("Anat. descript." t. iii. p. 186,) the right common iliac was wanting, and the internal and external iliacs of that side arose as distinct branches from the aorta.

Occasional offset. The common iliac artery, it should be added, often gives off a small unnamed branch to the lymphatic glands, the ureter or the psoas muscle [plates 53, 57], and sometimes even a larger branch—a renal artery or the ilio-lumbar [plate 57, fig. 6].

INTERNAL ILIAC ARTERY.

Internal iliac artery; The internal iliac artery (hypogastrica, pelvica), fig. 138, *r*, [plates 53 to 55,] a short and thick trunk, separates from the external iliac immediately after its origin, and dips into the pelvis to supply the walls and the viscera of that cavity. This artery is usually about an inch and a half in length, and is smaller than the external iliac, except in the fœtus. It extends from the bifurcation of the common iliac artery towards the sacro-sciatic foramen, and separates near that point into two divisions. At its origin, the artery lies near

its course and connections. the inner border of the psoas muscle; lower down, it rests against part of the pyriform muscle. Behind it are situate the internal iliac vein, and the communicating branch which passes from the lumbar to the sacral plexus of nerves: in front it is crossed by the ureter, which separates it from the peritoneum.

Various states. *Peculiarities.*—Considered in a surgical point of view, the deviations of this artery from its ordinary condition, in regard to its length and place of division, are important.

Length; *Length.*—In two thirds of a large number of cases, the length of the internal iliac artery varied between an inch and an inch and a half; in the remaining third it was much more frequently longer than shorter

than those measurements, the artery being in the extreme cases about half an inch and three inches in extent.

The lengths of the common iliac and internal iliac arteries bear an inverse proportion to each other—the internal iliac being long when the common iliac is short, and *vice versâ*. Moreover, when the common iliac is short, the internal iliac (arising higher than usual) is placed for some distance out of the pelvis, and descends by the side of the external iliac to reach that cavity [plate 57, fig. 9]. In inverse proportion to common iliac.

The *place of division* of the internal iliac into its branches varies between the upper margin of the sacrum and the upper border of the sacro-sciatic foramen. Place of division.

The *length* of the internal iliac arteries of the two sides was, in a series of cases, often found to differ, but neither seemed habitually to exceed the other [op. cit. p. 437]. Length;

Size.—When the main blood-vessel for the lower limb is derived from the internal iliac, and passes through the sacro-sciatic notch, this vessel exceeds much the external iliac in its proportions. may be very large;

Absence.—In one body * it has been found wanting on the left side: in this instance the external iliac of the same side was bent into the pelvis, and supplied visceral offsets to compensate for the absent arterial trunk. or absent.

The *internal iliac artery in the fœtus* (*hypogastric*) curves forwards from the common iliac artery to the side of the urinary bladder. In this course it descends but little, as the bladder projects into the abdomen in early life. Coursing upwards by the side and fundus of that organ, the vessel reaches the anterior wall of the abdomen, along which it ascends towards the umbilicus, converging to the vessel of the opposite side. At the umbilicus the two arteries come into contact with the umbilical vein, and then escaping with that vein from the abdomen, coil round it in the umbilical cord, and ramify in the substance of the placenta. In the fœtus it is large; To that part of the vessel which is placed within the abdomen, the term *hypogastric* is applied; the remaining portion, thence onwards through the umbilicus to the placenta, being the proper *umbilical* artery. part called hypogastric, part umbilical; In the first part of its course each vessel lies along the margin and side of the pelvis, covered by the peritoneum and crossed by the ureter; it next lies between that membrane, and the side of the bladder to which it gives branches (*superior vesical*), and is crossed in the male by the vas deferens; and finally, it ascends towards the umbilicus, between the peritoneum and the fascia transversalis, the latter separating it from the rectus muscle and its sheath.

* The preparation showing this condition is in the Museum of Univ. Coll., Lond.

in great part obliterated after birth.

Fossæ of peritoneum.

After the cessation of the placental circulation at birth, the two hypogastric arteries become impervious from the side of the bladder upwards to the umbilicus, and are converted into fibrous cords. These two cords, which extend from the sides of the bladder to behind the umbilicus, being shorter than the sac of the peritoneum on which they rest, cause the serous membrane to project inwards, and thus are formed two fossæ (fossæ of the peritoneum) on each side of the abdomen. The part of the artery intervening between the origin of the vessel and the side of the bladder, still continues pervious, and though reduced proportionately in size, continues to convey blood to the bladder, constituting the superior vesical artery.

Branches are given from two divisions of artery;

Branches.—The branches of the internal iliac artery, though constant and regular in their existence and general distribution, vary much in their origin. Some are distributed to the parts or organs within the pelvis, viz., to the rectum, the urinary bladder, and the organs peculiar to the female, as well as to the spinal canal; whilst others of larger size supply chiefly the muscles upon the outer side of the pelvis. The branches furnished to these several structures will, in most cases, be observed to arise from two principal parts of the parent trunk, of which one is anterior to the other. From the anterior portion the following branches usually arise; viz., the superior vesical (the pervious portion of the fœtal hypogastric artery), the inferior vesical, middle hæmorrhoidal, obturator, internal pudic, and sciatic arteries, with the uterine and the vaginal in the female. The posterior division gives off the gluteal, the ilio-lumbar and the lateral sacral arteries.

names of these.

Peculiarities in branches.

Sometimes all the branches of the internal iliac artery arise without the previous separation of that vessel into two portions.

In more than a fourth of a large number of cases noted, a branch arose before the subdivision of the main trunk. This branch was usually the ilio-lumbar artery [plate 65, fig. 7].

VESICAL ARTERIES.

Vesical arteries.

The urinary bladder receives several arteries, amongst which, however, may be specially recognised two principal branches, a superior and an inferior vesical artery [plates 60, 63, fig. 2].

Superior vesical.

The *superior* vesical artery is that part of the hypogastric artery in the fœtus which remains pervious after the

changes that take place subsequently to birth. It extends from the anterior division of the internal iliac to the side of the bladder.

It distributes numerous *branches* to the upper part and sides of the bladder; from one of the lowest of these a slender artery reaches the vas deferens, and accompanies that duct in its course to the back of the testicle, where it anastomoses with the spermatic artery. This is the *artery of the vas deferens*, or the *deferent artery*. Other small branches ramify on the lower end of the ureter. Branches to bladder. Deferent artery.

The *inferior vesical* artery (vesico-prostatic: vesicalis ima, —Haller), derived usually from the anterior division of the internal iliac, is directed downwards to the lower part of the bladder, where it ends in branches which are distributed to the base of the bladder, to the side of the prostate, and to the vesiculæ seminales. One offset, to be presently described, descends upon the rectum. Inferior vesical;

The branches upon the prostate communicate more or less freely upon that body with the corresponding vessels of the opposite side, and, according to Haller, with the perinæal arteries likewise [plate 59]. prostatic branches.

Besides the superior and inferior vesical arteries, other smaller branches will be found to reach the bladder, and usually one slender vessel which is distributed particularly to the under surface of the vesiculæ seminales. Other vesical branches.

Middle hæmorrhoidal artery.—The branch supplied by the inferior vesical artery to the rectum is the middle hæmorrhoidal. It anastomoses with the branches of the other hæmorrhoidal arteries. Hæmorrhoidal branch.

UTERINE AND VAGINAL ARTERIES.

The uterine artery [plates 59, 63, fig. 1] is directed downwards from the anterior division of the internal iliac artery towards the neck of the uterus. Insinuating itself between the layers of the broad ligament, it passes upwards at the side of the uterus, pursuing an exceedingly tortuous course, and sends off numerous branches, which enter the substance of that organ. Uterine artery; is very tortuous;

This artery supplies small branches to the bladder and the ureter; and, near its termination, communicates with an offset directed inwards from the ovarian artery. anastomoses with ovarian artery.

Vaginal artery.—The vagina derives its arteries principally from a branch which is representative of the inferior vesical Vaginal artery.

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from epigastric. foramen; and in this course it is necessarily close to the femoral ring —an opening at the inner side of the external iliac vein, through which hernial protrusions descend from the abdomen into the thigh. The artery is usually directed backwards close to the iliac vein, and therefore lies to the outer side of the femoral ring; but it occasionally crosses behind the ring; and curves to its inner side in some cases. The position of the vessel in such cases, and the practical inferences to be deduced from it, will be again referred to in the anatomical history of the parts concerned in femoral hernia.

PUDIC ARTERY.

Pudic artery; larger in male. The pudic or internal pudic artery (pudica interna; pudica communis, — Winslow; pudenda (simpliciter), — Haller), is a branch of considerable size (smaller in the female than in the male), which is distributed to the external generative organs. The following description of this artery has reference to its arrangement in the male; its distribution in the female will be noticed separately.

Origin; outline of course; The pudic artery [plate 60] arises from the anterior division of the internal iliac, sometimes by a trunk common to it and the sciatic artery. At first it inclines downwards and outwards to reach the great sacro-sciatic foramen, through which it escapes from the pelvis with the sciatic artery. It next enters the ischio-rectal fossa through the small sciatic foramen, turning round the spinous process which separates those two foramina from each other. In this way the artery reaches the inner side of the tuber ischii, from which point it runs forwards and upwards along the pubic arch, and divides into two ultimate branches.

describes a long curve. In this long course, it will be noticed that the artery describes a large curve along the lower part of the pelvis, the concavity of which is directed upwards; whence, doubtless, the name once applied to it, *pudenda circumflexa*.

Connections, in pelvis; In the first part of its course, whilst within the pelvis, the pudic artery lies to the outer side of the rectum on the left side, and in front of the pyriformis muscle and the sacral nerves. outside pelvis; The very short part of the vessel which is outside the pelvis is immediately in contact with the ischial spine near the point, close to the attachment of the small sacro-sciatic ligament, and is deeply placed beneath the great gluteal muscle. after return within pelvis; After re-entering inside the pelvis the pudic artery lies to the inner side of the internal obturator muscle, lodged with its nerve in a fibrous canal formed by the pelvic fascia. Here it lies along the outer

side of the ischio-rectal fossa, and is in some degree protected below by the falciform process of the great sacro-sciatic ligament.

Position in perinæum. Distant at first from the lower margin of the ischial tuberosity an inch or an inch and a half, and very deeply placed, the artery, in curving forwards towards the perinæum, gains the inner margin of the pubic arch, and at the same time gradually approaches nearer the surface. Piercing the posterior layer of the deep perinæal fascia, it runs upwards close to the crus penis towards the pubes, at the same time converging towards its fellow of the opposite side. Finally, after perforating the superficial layer of the deep perinæal fascia, the pudic artery divides into its two ultimate branches, viz., the dorsal artery of the penis, and the artery of the corpus cavernosum.

Terminal branches.

Vein and nerve. The artery is accompanied by the pudic vein and the internal pudic nerve.

Branches. *Branches.*—Before escaping from the pelvis, the pudic artery gives occasionally small and irregular branches to the muscles and to the sacral nerves; and, besides its two terminal branches, it furnishes the following named branches in the perinæum.

Inferior hæmorrhoidal. The *inferior* or *external hæmorrhoidal* arteries, fig. 150, *b*, two or three in number, incline inwards from the pudic artery as it crosses above the tuber ischii. These small vessels run across the ischio-rectal fossa, through the fat in that hollow, and are distributed to the sphincter and levator ani muscles, and to the parts about the anus.

Superficial perinæal. The *superficial perinæal* artery, *c*, is a long, slender, but regular vessel, which supplies the scrotum and the upper part of the perinæum. Given from the pudic artery in front of the preceding vessels, it turns upwards parallel with the pubic arch. The perinæal artery crosses the transverse muscle of the perinæum, and runs forwards under cover of the superficial fascia, and between the erector penis and accelerator urinæ muscles, supplying both. In this course the artery gradually becomes superficial, as it ascends, and is finally distributed to the skin of the scrotum and the dartos. It not unfrequently gives off the following branch.

Transverse perinæal. The *transverse perinæal* artery, *d*, arises either from the pudic artery, or from the preceding branch, near the transversus perinæi muscle. This small vessel lies across the perinæum, as the name implies, and terminates in small

branches which are distributed to the transverse muscle, and to the parts between the anus and the bulb of the urethra. It is a very small artery.

Fig. 150.*

Artery of bulb.

The *artery* of the *bulb*, *e*, is, surgically considered, an important vessel. It is very short; arising from the pudic between the layers of the triangular ligament, and passing transversely inwards, this artery reaches the bulb a little in front of the end. Having entered the bulb, it ramifies in the erectile tissue. It gives a branch to Cowper's gland.

Profunda penis.

The *artery* of the *corpus cavernosum*, *f* (profunda penis), one of the terminal branches of the internal pudic, runs a short distance between the crus penis and the bone, and then continuing forwards penetrates the crus, and ramifies in the corpus cavernosum.

Dorsalis penis.

The *dorsal artery of the penis*, *g*, runs between the crus and the pubic symphysis; having pierced the suspensory ligament, it continues along the dorsum of the penis immediately beneath the skin, and parallel with the dorsal vein, as well as with the corresponding artery of the opposite side. It supplies the integument of the penis, and the fibrous sheath of the corpus cavernosum, anastomosing with

* The pudic arteries and those seen in the perinæum. *a*, pudic; *b*, inferior hæmorrhoidal; *c*, perinæal; *e*, artery of bulb; *f*, cavernous; *g*, dorsal of penis.

the deep arteries. Near the corona glandis, each dorsal artery divides into branches, which supply the glans and the prepuce.

Peculiarities of the pudic artery.—Changes in its place of origin have already been noticed. The artery itself is sometimes small, or defective in one or two, or but rarely three of its usual branches. In these cases, its deficiencies are supplied by a supplemental vessel which has been elsewhere named the "*accessory pudic*" [op. cit. p. 443]. The defect most frequently met with is that in which the pudic ends as the artery of the bulb, whilst the artery of the corpus cavernosum and the dorsal branch of the penis are derived from the accessory pudic [plate 63, fig. 3]. But the three arteries of the penis may be supplied by the accessory pudic; the pudic itself ending as the superficial perinæal [plate 64, fig. 3]. In one case, a single accessory pudic supplied both "cavernous" arteries, whilst the pudic of the right side gave both dorsal arteries [p. 444]. And, on the other hand, cases have occurred in which only a single branch was furnished by the accessory artery, either to take the place of an ordinary branch altogether wanting, or to aid one of the branches which happened to be diminutive in size [plate 64, fig. 4, 65, fig. 1].

Peculiarities of pudic trunk.

Accessory pudic artery.

The *accessory pudic*, the occasional artery above alluded to, generally arises from the pudic itself, before the passage of that vessel from the sacro-sciatic foramen [plate 63, fig. 3], and proceeds forwards near the lower part of the bladder. "In passing by the prostate and urethra—and it is here that the exact situation of this artery is of serious concern to the practical surgeon—the accessory pudic lies on the upper part of the gland, or it may be, for a short space, likewise on the posterior margin; and then proceeding forwards above the membranous part of the urethra, it reaches the perinæum and divides into the terminal branches" [op. cit. p. 444]. In only one case it was seen to approach the side of the prostate.

Course of accessory pudic;

The accessory pudic sometimes arises with the other branches from the internal iliac [plate 63, fig. 5]; and a vessel having a similar distribution may spring from the external iliac, through an irregular obturator [plate 65, fig. 1], or through the epigastric; in the two last-named cases, it descends directly behind the pubes.

and its origin.

Peculiarities of the branches.—Artery of the bulb. From the connection of this vessel with the operation of lithotomy, its various conditions require special notice. It is sometimes small, sometimes wanting on one side, and, occasionally, it is double [plate 64].

Variations in branches.

But a more important deviation from the common condition of the artery of the bulb is one sometimes met with, in which the vessel, arising earlier than usual, crosses the perinæum farther back than in the ordinary arrangement, and reaches the bulb from behind. In such a case there would be considerable risk of dividing the artery in performing the lateral operation for stone [plate 64, fig. 2].

Unusual course of bulb artery.

On the contrary, when this small vessel arises from an accessory pudic artery, it lies higher or more forward than usual [fig. 3], and out of danger in case of operation.

The *dorsal* artery of the penis has been observed to arise from the deep femoral artery and to pass obliquely upwards and inwards to reach the root of the penis. Tiedemann gives a drawing of this variety.

Dorsal artery.

Artery in female.

The *pudic artery in the female.*—In the female this vessel is much smaller than in the male. Its course is similar, and it supplies the following *branches:*

Branches.

The *superficial perinæal* branch is distributed to the labia pudendi. The *artery of the bulb* supplies the mass of erectile tissue above and at the sides of the entrance of the vagina, named the bulb of the vagina. Whilst the two terminal branches, resembling the artery of the corpus cavernosum and the dorsal artery of the penis, are distributed to the clitoris, and are named the *profunda* and *dorsal* arteries.

Peculiarities.

The arteries of the clitoris were found in one case to be derived from the accessory pudic artery, which took its origin from the epigastric artery [op. cit. p. 443].

THE SCIATIC ARTERY.

Sciatic artery;

course.

The sciatic artery, the largest branch of the internal iliac trunk, excepting the gluteal, is distributed to the muscles on the back of the pelvis. Continuing downwards from the anterior division of the internal iliac artery, it is placed for some distance upon the pelvic surface of the pyriformis muscle and the sacral plexus of nerves; turning backwards beneath the border of that muscle, it passes between this and the superior gemellus, and thus escapes from the pelvis, with the great sciatic nerve and the pudic artery, at the lower part of the great sciatic foramen. When on the outside of the pelvis, this artery lies in the interval between the tuber ischii and the great trochanter, covered by the gluteus maximus. The sciatic artery gives off several branches to the external rotator muscles of the thigh, on which it lies, and to the great gluteus which conceals it.

Branches.

Two only of its *branches* have received special names: viz.,

Coccygeal branch;

One, an internal branch, named *coccygeal*, inclines inwards, and piercing the great sacro-sciatic ligament, reaches the posterior surface of the coccyx, and ramifies in the fat and skin about that bone.

branch to sciatic nerve;

The other named branch, *comes nervi ischiadici*, runs downwards, accompanying the sciatic nerve, along which it sends a slender vessel.

to hip-joint.

Anastomotic.

Some of the branches of this artery are distributed to the capsule of the hip-joint; whilst others, after supplying the contiguous muscles, anastomose with the gluteal, the internal circumflex, and the superior perforating arteries.

GLUTEAL ARTERY.

The gluteal artery (iliaca posterior,—Haller), the largest branch of the internal iliac, is distributed to the muscles on the outside of the pelvis. It inclines downwards towards the upper border of the great sacro-sciatic foramen, beneath which it turns, and escapes from the cavity of the pelvis in the interval between the contiguous borders of the middle gluteal and pyriform muscles. Whilst within the pelvis, it gives off a few small branches to the muscles; as it turns out of that cavity it sends off a larger offset (nutritia magna,—Haller), which enters the substance of the hip-bone. On reaching the outer surface of the bone, the gluteal artery immediately divides into a superficial and a deep branch.

Gluteal artery. Course; muscular branches; offset to bone;

The *superficial* branch, running between the gluteus maximus and medius, gives off in its course many smaller branches, some of which, after piercing the tendinous origin of the great gluteal muscle, approach the side of the sacrum, anastomosing with the posterior branches of the sacral arteries, and supplying the integuments there; whilst others of considerable size pass outwards between the gluteal muscles, and supply them freely.

its superficial branch;

The *deep* branch, situate between the gluteus medius and minimus, runs in an arched direction forwards, and divides into two other branches. One of these (the superior branch), continuing the course of the vessel from which it arises, runs along the upper border of the gluteus minimus beneath the middle gluteal muscle and the tensor of the fascia lata, towards the anterior iliac spine, anastomosing with the circumflex iliac and with the ascending branches of the external circumflex arteries, after having freely supplied the muscles between which it passes. The second or inferior branch descends towards the great trochanter, supplies the gluteal muscles, and anastomoses with the the external circumflex and the sciatic arteries.

deep branch.

ILIO-LUMBAR ARTERY.

The ilio-lumbar artery (ilio-lumbalis,—Haller) resembles in a great measure the lumbar arteries. It passes outwards beneath the psoas muscle and the external iliac vessels, to

Ilio-lumbar artery;

reach the margin of the iliac fossa, where it divides into two principal branches.

its lumbar and its

One of these, the *lumbar* branch, passes upwards, ramifying in the psoas and quadratus muscles, communicating with the last lumbar artery ; it furnishes also small vessels which enter the intervertebral foramina, and supply the parts lodged in the vertebral canal.

iliac branches.

The other or *iliac* branch of the artery turns downwards and outwards, either in the substance of the iliacus muscle, or between this and the surface of the hip-bone. Some of its branches reach the crest of that bone, where they anastomose with the circumflex iliac artery, and may be traced forwards through the abdominal muscles, which they supply, and in which they communicate with the external branches of the epigastric artery.

Peculiarities; origin;

The ilio-lumbar artery, as already mentioned, sometimes arises from the internal iliac, above the division of that trunk [plate 65, fig. 4]. It has been also found to spring from the common iliac, but this latter peculiarity is rare [plate 57, fig. 6]. The iliac and lumbar portions of the ilio-lumbar artery sometimes arise separately from the parent trunk.

size.

When the lowest of the lumbar arteries is wanting, the ilio-lumbar is increased in size, and, with a small offset of the middle sacral artery, supplies its place.

LATERAL SACRAL ARTERIES.

Lateral sacral arteries;

The *lateral sacral* arteries, which are usually two in number on each side (occasionally but one), arise close together from the posterior division of the internal iliac artery. One of them is distributed along the upper, and the other along the lower part of the sacrum in the following manner.

course on sacrum.

Each artery passes downwards, at the same time inclining somewhat inwards, in front of the pyriform muscle and the sacral nerves, to reach the inner side of the anterior sacral foramina. Continuing to descend, the lower one approaches towards the middle line, and anastomoses with the middle sacral artery. Branches from these arteries ramify in front of the sacrum, and supply small offsets to the pyriform muscle and sacral nerves.

Dorsal branch to spinal canal and behind sacrum.

Besides these branches, the lateral sacral arteries give off a series of *dorsal* branches, which enter the anterior sacral foramina. Each of these, after having furnished within the foramen a spinal branch, which ramifies on the bones and

membranes in the interior of the sacral canal, escapes by the corresponding posterior sacral foramen, and is distributed upon the dorsal surface of the sacrum [plate 87, fig. 1].

EXTERNAL ILIAC ARTERY.

The vessel which supplies the lower extremity forms a continuous trunk from the point of division of the common iliac artery down to a little below the knee, viz., to the lower border of the popliteus muscle, where it divides into the anterior and posterior tibial arteries; but though thus continued as a single trunk, different parts of the vessel have received different names, taken from the anatomical regions through which they pass. Whilst within the pelvis, it is named iliac; in the upper two-thirds of the thigh, femoral; and thence to its termination, popliteal. These subdivisions however are artificial, and are intended merely to facilitate reference to the vessel in different situations.

Artery of lower limb; its different names.

The external iliac artery, fig. 138, *s*; fig. 151, A [plate 53], larger, except in the fœtus, than the internal iliac artery, is placed within the abdomen, and extends from the division of the common iliac to the lower border of Poupart's ligament, where the vessel entering the thigh assumes the name femoral. Descending obliquely outwards, its course through the abdominal cavity would be marked by a line drawn from the left side of the umbilicus to a point midway between the anterior superior iliac spinous process and the symphysis pubis. This line would also indicate the direction of the common iliac artery, from which the external iliac is directly continued.

External, iliac artery; situation, extent, course, and

Placed within the abdominal cavity, the vessel is covered by the peritoneum and intestines. It lies along the upper margin of the true pelvis, resting along the inner border of the psoas muscle. The artery, however, is separated from the muscle by the fascia iliaca, to which it is bound, together with the external iliac vein, by the subserous layer of membrane.

connections with other parts;

Veins.—The external iliac vein lies at first behind the artery with an inclination to the inner side; but as both vessels approach Poupart's ligament at the fore part of the pelvis, the vein is on the same plane with the artery and to the inner side, being borne forwards by the bone. At a short distance from its lower end the artery is crossed by

with external iliac and circumflex iliac veins.

the circumflex iliac vein. Lymphatic glands are found resting upon the front and inner side of the vessel; and the spermatic vessels descend upon it near its ending [plate 55]. A branch of the genito-crural nerve crosses over it just above Poupart's ligament.

Number of branches. The external iliac artery supplies some small *branches* to the psoas muscle and to the neighbouring lymphatic glands, and two other branches of considerable size, named the epigastric and the circumflex iliac, which are distributed to the walls of the abdomen.

Peculiarities; size; *Size.*—In those rare cases in which the large blood-vessel of the lower limb is continued from the internal iliac [p. 349] this artery is correspondingly diminished, and ends in the muscles of the front of the thigh, taking the place of the profunda.

increase in number. The usual *number* of the two principal branches may be increased by the separation of the circumflex iliac into two branches [plate 65, fig. 5]; or by the addition of a branch usually derived from another source, as the internal circumflex artery of the thigh [plate 74, fig. 2], or the obturator artery [plate 65, figs. 4, 5, 6].

decrease. On the contrary, the branches are now and then diminished in number by the transference of the epigastric or the circumflex iliac artery to another trunk, which is commonly the femoral.

EPIGASTRIC ARTERY.

Epigastric artery; origin; course; The epigastric artery (epigastrica inferior), fig. 138, *t*; fig. 151, *a*, [plate 65,] arises from the fore part of the external iliac artery, usually a few lines above Poupart's ligament. At first the artery inclines downwards, so as to get on a level with the ligament, and then changing its direction passes obliquely upwards and inwards between the fascia transversalis and the peritoneum, to reach the rectus muscle of the abdomen. It then ascends almost vertically

behind rectus muscle and in its sheath; behind that muscle, being placed between it and its sheath, where this latter exists. Having given off lateral muscular branches, the epigastric artery terminates above the umbilicus in several offsets, which ramify in the substance of the muscle, and anastomose with the terminal branches of the internal mammary and inferior intercostal arteries; some of its branches communicate also with offsets from the lumbar arteries.

two veins. The epigastric artery is accompanied by two *veins*, which unite into a single trunk before ending in the external iliac vein.

Position to In its course upwards from Poupart's [illegible] to the

rectus muscle, the artery crosses close to the inner side of the internal abdominal ring; and in this situation the vas deferens, escaping from the ring, turns behind the artery in descending into the pelvis.

abdominal ring and vas deferens.

Fig. 151.*

Branches.

The *branches* of the epigastric artery are small, but numerous.

Cremasteric artery.

The *cremasteric* artery, a slender branch, accompanies the spermatic cord, and supplying the cremaster muscle and other coverings of the cord, anastomoses with the spermatic artery.

Muscular;

Several *muscular* branches arise from each side of the epigastric artery, ramify in the rectus muscle, and communicate with the branches of the lumbar and circumflex iliac arteries; whilst others — *superficial* branches, perforate the abdominal muscles, and join beneath the skin with branches of the superficial epigastric artery.

superficial,

and pubic branches.

The epigastric artery furnishes also a small *pubic* branch, which ramifies behind the pubes, and communicates by means of a descending branch or branches with a similar offset from the obturator artery, as already described in treating of the branches of that vessel.

Unusual origin.

Peculiarities of the epigastric artery.— This artery occasionally *arises* an inch and a half, or even two inches and a half, above Poupart's ligament; and it has been seen to arise below that ligament from the femoral, or from the deep femoral. The epigastric frequently furnishes the obturator artery [plate 66];

* A sketch to show the arteries with the muscles of the thigh. 1. Psoas muscle. 2. Rectus. 3. Pectineus. 4. Long adductor. 5. Great adductor. 6. Gracilis. 7. Vastus internus. A. Iliac artery. B. Femoral. C. Deep femoral. *a.* Epigastric. *b.* Circumflex iliac. *c.* Superficial circumflex iliac. *d.* Superficial epigastric. *e.* External pudic. *f.* External circumflex (erroneously represented over the rectus). *g.* Internal circumflex. *h.* Perforating.

and on the other hand two examples are recorded in which the epigastric artery arose from the obturator, that vessel being furnished by the internal iliac artery [plate 72, fig. 1].* In a single instance, the epigastric artery was represented by two branches, one arising from the external iliac, and the other from the internal iliac artery.† Some combinations of the epigastric with the internal circumflex, or with the circumflex iliac, or with both those vessels, have been noticed [op. cit. p. 457].

Double epigastric.

CIRCUMFLEX ILIAC ARTERY.

Circumflex iliac artery;

The circumflex iliac artery, fig. 138, *v*; fig. 151, *b*, [plate 53,] smaller than the preceding vessel, arises from the outer side of the iliac artery near Poupart's ligament, and is directed outwards behind that band to the anterior superior iliac spine. Following the crista of the hip-bone, the artery gives branches to the iliacus muscle, furnishing others which are distributed to the abdominal muscles, and anastomoses with the ilio-lumbar artery. In its course outwards this artery lies in front of the transversalis fascia, at the junction of this with the fascia iliaca.

runs along iliac crest.

Two companion veins.

Two *veins* accompany the circumflex iliac artery; these unite below into a single vessel, which crosses over the external iliac artery about an inch above Poupart's ligament, and enters the external iliac vein [plate 55].

Abdominal branch.

Near the iliac crest, this artery gives off a *muscular* branch, which ascends on the fore part of the abdomen between the transversalis and internal oblique muscles; and having supplied those muscles, it anastomoses with the lumbar and epigastric arteries [plate 53]. This branch varies very much in size, and is occasionally represented by small muscular offsets.

Change in origin;

Peculiarities.—The place of *origin* of the circumflex iliac artery sometimes deviates from its ordinary position,—the artery arising at a distance not exceeding an inch above Poupart's ligament. Deviations in the opposite direction are more rarely met with; it has in a few cases been observed to arise below the ligament, and therefore from the femoral artery. The circumflex iliac artery is sometimes represented by two separate branches from the external iliac [plate 58, fig. 1].

is sometimes double.

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* Monro, "Morbid Anatomy of the Human Gullet," &c., p. 427. A. K. Hesselbach, "Die sicherste Art des Bruchschnittes," &c.

† Lauth, in "Velpeau's Médecine Opératoire," t. ii. p. 452.

FEMORAL ARTERY.

The femoral artery (femoralis cruralis), fig. 151, B, [plate 69,] is that portion of the artery of the lower limb which lies along the upper two-thirds of the thigh,—its limits being marked above by Poupart's ligament, and below by the opening in the great adductor muscle, after passing through which the artery receives the name popliteal. Femoral artery; its extent;

A general idea of the direction of the femoral artery over the fore part and inner side of the thigh would be obtained by a line reaching from a point midway between the anterior superior iliac spine and the symphysis of the pubes to the inner side of the internal condyle of the femur. But the situation of the vessel is best ascertained by observation of the surface at the upper part of the thigh, inasmuch as it lies along the middle of a depression formed between the muscles covering the femur on the outer side, and the adductor muscles on the inner side of the limb. In this situation the beating of the artery may be felt, and the circulation through the vessel be most easily controlled by pressure. direction and position;

Owing to the natural curvature of the femur, and to the passage of the femoral artery from the front towards the back of the thigh, the relative position of the vessel and the bone varies considerably at different points. Thus at the groin the artery, after having passed over the margin of the pelvis, is placed slightly in front of or internal to the head of the femur; and at its lower end, the vessel lies close to the inner side of the bone; whilst in the intervening space, in consequence of the projection of the neck and shaft of the femur outwards, while the artery holds a straight course, the two are separated by a considerable interval. position in regard to femur.

Becoming deeper as it descends, the femoral artery is at first comparatively near the surface, being covered in the upper third of the thigh by the common integuments and the fascia lata, in addition to the sheath which contains both the artery and the vein. In this situation a triangular space may be recognised by dissection upon the fore part of the thigh, immediately below the fold of the groin. The apex of this triangle is directed downwards, its sides are formed respectively by the sartorius and the long adductor muscles, and its base by the lower margin of the abdominal wall Upper part of vessel near surface, in a triangular space in front of thigh.

which is represented by Poupart's ligament. This triangular interval is divided into two nearly equal parts by the femoral vessels, which extend from the middle of the base to near the apex.

Lower part covered by muscle and a fibrous layer.

Below the part just referred to, the femoral artery is deeply placed, being covered by the sartorius muscle, which, after crossing obliquely from the outer to the inner side of the thigh, descends vertically and covers the artery to its end. The vessel is likewise covered, beneath the muscle, by a dense stratum of fibrous structure, which stretches across from the tendons of the long and great adductors to the vastus internus muscle.

Parts behind the artery.

The artery rests successively against the following parts. First, upon the psoas muscle, by which it is separated from the margin of the pelvis and the capsule of the hip-joint; next upon, or rather in front of the pectineus muscle, the deep femoral artery and vein being interposed; afterwards upon the long adductor muscle; and lastly upon the tendon of the great adductor, the femoral vein being placed between the tendon and the artery.

At the lower part of its course, the femoral artery has immediately on its outer side the vastus internus muscle, which intervenes between it and the inner side of the femur.

Connections with veins;

Veins.—The femoral vein is very close to the artery, both being enclosed in the same sheath, separated from each other only by a thin partition. At the groin the vein lies on the same plane as the artery, and on the inner side; but gradually inclining backwards, it afterwards sinks behind that vessel, and even gets somewhat to the outer side. The deep femoral vein, near its termination, crosses behind the femoral artery; and the long saphenous vein, as it ascends on the fore part of the limb, lies to the inner side [plate 71, fig. 1]; but it not unfrequently happens that a superficial vein of considerable size ascends for some space directly over the artery [plate 70].

with nerves.

Nerves.—At the groin the anterior crural nerve lies a little to the outer side of the femoral artery (about a quarter of an inch), separated from the vessel by some fibres of the psoas muscle and by fascia [plate 71, fig. 1]. Lower down in the thigh, the long saphenous nerve accompanies the artery until this vessel perforates the adductor magnus. There are likewise small cutaneous nerves which cross the artery.

Peculiarities.—There does not appear to be any well-authenticated example of the femoral artery furnishing the arteries of the leg; and in this respect the leading vessel of the lower limb contrasts strongly with that of the arm.* High division not known.

Four instances have been recorded [see op. cit. p. 515] of division of the femoral artery below the origin of the profunda into two vessels, which subsequently reunited near the opening of the adductor magnus so as to form a single popliteal artery [plate 71, fig. 2].† In all these cases, the arrangement of the vessels appears to have been similar. To one of them (that first observed) special interest is attached, inasmuch as it was met with in a patient operated upon for popliteal aneurism. Double femoral: reunion of parts

The femoral artery is occasionally placed at the back instead of the front of the thigh. In this condition of the main vessel of the limb, the artery is continuous with the internal iliac trunk. Having passed from the pelvis through the large sacro-sciatic notch, it accompanies the great sciatic nerve along the back of the thigh to the popliteal space, where its connections and ending become similar to those of the vessel with the usual arrangement. Four examples of this deviation from the common state of the blood-vessel have been recorded.‡ Femoral artery at the back of the thigh.

Branches.—The femoral artery gives off the following branches. Some, small and superficial, which are distributed to the integument and glands of the groin, and ramify on the lower part of the abdomen, viz., the external pudic (superior and inferior), the superficial epigastric, and the superficial circumflex iliac; the great nutrient artery of the muscles of the thigh, named the deep femoral; several small muscular branches; and lastly, the anastomotic artery, which descends on the inner side of the knee-joint. Branches of femoral artery; their names.

Besides the foregoing ordinary branches, the femoral artery sometimes gives origin to some offsets, usually derived from other sources; as, for example, the circumflex arteries (branches of the deep femoral), or, but more rarely, the epigastric, the circumflex iliac, or the obturator arteries. These will be noticed in the account of the individual branches. Unusual branches.

SUPERFICIAL INGUINAL BRANCHES.

The *external pudic arteries*, fig. 151, *c*, [plates 69, 70,] External pudic arteries;

* For an examination of the history of four cases, which have been regarded as examples of the early division of the femoral artery, see "The Arteries," &c., by R. Quain, p. 514.

† This case was treated and recorded by Sir C. Bell: "The London Medical and Physical Journal," vol. lvi. p. 134. London, 1826.

‡ Reference is made to these in a Paper in vol. 36 of the Med. Chir. Trans., giving an account of a specimen of remarkable deformity of the lower limbs of a man, in whom the artery was so transposed on both sides.

arise either separately or by a common trunk from the inner side of the femoral artery. The *superior*, the more superficial branch (superior pudenda externa,—Haller), courses upwards and inwards to the pubic spine, crosses the external abdominal ring, passing in the male over the spermatic cord, and is distributed to the integuments on the lower part of the abdomen, and on the external organs of generation. The *inferior* branch (inferior pudenda externa), more deeply seated, extends inwards, resting on the pectineus muscle, and covered by the fascia lata, which it pierces on reaching the inner border of the thigh, and is distributed to the scrotum in the male, or to the labium in the female, its branches inosculating with those of the superficial perinæal artery.

superior;

inferior.

Superficial epigastric artery.

The *superficial epigastric* artery, *d*, arising from the femoral vessel, about half an inch below Poupart's ligament, passes forwards through the fascia lata; after which it changes its direction, and runs upwards on the abdomen in the superficial fascia covering the external oblique muscle. Its branches ramify in the superficial fascia and integument on the lower part of the abdomen; and some, ascending nearly as high as the umbilicus, anastomose with those of the epigastric and internal mammary arteries.

Superficial circumflex iliac.

The *superficial circumflex iliac* artery, *e*, runs outwards in the direction of Poupart's ligament towards the iliac spine, across the psoas and iliacus muscles; to both of these it gives small branches, as also some others which pierce the fascia lata; it is distributed to the integument.

All the preceding arteries give small branches to the lymphatic glands in the groin.

THE DEEP FEMORAL ARTERY.

Deep femoral artery;

its large size;

The deep femoral artery (profunda femoris), fig. 151, c, [plate 69,] is the principal nutritious vessel of the thigh; its branches being mainly distributed to that part of the lower limb, whereas the femoral artery supplies the leg and foot. It is a vessel of considerable calibre, being nearly equal in size to the continuation of the femoral after the origin of this great branch.* It usually arises from the

* The artery of the lower limb, after emerging from the abdominal cavity, was described by Murray as the *common femoral*, and was regarded by him as dividing into two parts, which he named respectively, the *superficial*, and the *deep* femoral arteries. These terms are often conveniently used by surgical writers for easy reference to different parts of the vessel.

outer and back part of the femoral artery, between an inch and two inches below Poupart's ligament. The artery at first inclines outwards in front of the iliacus muscle, but soon changes its course, running downwards and backwards behind the femoral artery. Opposite the junction of the upper with the middle third of the femur, the profunda artery passes behind the long adductor muscle, between it and the great adductor; and then inclining outwards towards the linea aspera of the femur, soon divides into its terminal branches, which pass backwards through the great adductor muscle, and ramify in the muscles at the back and outer part of the thigh. its course

The artery lies successively in front of the iliacus and pectineus muscles, and then on the adductor brevis and adductor magnus muscles. It is placed behind the femoral trunk; the femoral and profunda veins and the long adductor muscle being interposed between the two arteries. and connections.

Peculiarities.—The *origin* of the deep femoral artery sometimes deviates from its usual position on the parent trunk, being occasionally given off from the inner side [plate 73], and, but more rarely, from the back part of that vessel [plate 72 and 73, fig. 5]. Peculiarities in origin;

The *height* at which this artery arises from the femoral is subject to very great variation. In more than three-fourths of a large number of cases it was found to arise from the femoral at a distance of from one to two inches below the lower border of Poupart's ligament; in a few of the cases, the distance measured less than one inch; much more rarely, the profunda arose opposite to the ligament [plate 72, fig. 4]; and in a single instance above that structure [fig. 3], and, therefore, from the external iliac artery. above usual position;

On the other hand, the distance between the origin of the artery and Poupart's ligament was sometimes found to exceed two inches [plate 73, fig. 6]; and, in one instance, the artery arose as low down as four inches from the ligament [plate 72, fig. 5], but in that case the internal and external circumflex branches did not arise from it. below it.

Branches.—In addition to a number of small unnamed offsets to the muscles, the deep femoral artery furnishes the branches now to be described. Branches.

The *external circumflex* artery, *f*, a branch of considerable size, arises from the outer side of the profunda, and, after passing outwards for a short distance beneath the sartorius and rectus muscles, and through the divisions of the anterior crural nerve, gives off branches, which may be divided into three sets, according to the directions which they take. The *first* incline *transversely* outwards, and passing over the crureus muscle, pierce the vastus externus, External circumflex artery; its transverse,

so as to get between this muscle and the bone just below the great trochanter of the femur, and reach the back part of the thigh, where they anastomose with the internal circumflex and the perforating branches, also with the gluteal and sciatic branches. The *second* set, or the *ascending* branches, are directed upwards beneath the sartorius and rectus, and afterwards under the tensor muscle of the fascia lata; here they communicate with the terminal branches of the gluteal, and with some of the external descending branches of the circumflex iliac artery. The *third*, or *descending* set of branches, incline outwards and downwards upon the extensor muscles of the knee, covered by the rectus muscle. They are usually three or four in number, some being of a considerable size; most of them are distributed to the muscles on the fore part of the thigh, but one or two can be traced beneath the vastus externus muscle, as far as the knee, where they anastomose with the superior articular branches (internal and external) of the popliteal artery, and with the anastomotic branch of the femoral artery.

ascending, and descending branches.

Peculiarities.—The external circumflex branch sometimes arises as a single trunk from the femoral artery [plate 72, fig. 5]; or it may be represented by two branches, of which, in most cases, one proceeds from the femoral, and one from the deep femoral [plate 73, fig. 5]; both branches however have been seen to arise from the deep femoral [fig. 2], or, but much more rarely, both from the femoral artery [fig. 4].

Internal circumflex.

The *internal circumflex* artery, *g*, smaller than the preceding branch, arises from the inner and hinder part of the deep femoral artery, and is directed backwards between the pectineus and the psoas muscle to the inner side of the femur, so that only a small part of it can be seen without disturbing these muscles. On reaching the tendon of the external obturator, by which the vessel is guided to the back of the thigh, it divides into two principal branches.

Branches.

One, ascending, is distributed partly to the adductor brevis and gracilis, and partly to the external obturator muscle, near which it anastomoses with the obturator artery; the other, or transverse branch, passes backwards above the small trochanter, and appears on the back of the limb between the quadratus femoris and great adductor muscles, where it supplies the hamstring muscles, and anastomoses with the sciatic artery and with the superior perforating branches of the deep femoral artery. Opposite the hip-joint this transverse branch gives off an *articular* vessel, which

Articular artery.

enters the joint through the notch in the acetabulum, beneath the transverse ligament, and supplies the adipose tissue and the synovial membrane in that articulation; some offsets are guided to the head of the femur by the round ligament. In some instances the articular branch is derived from the obturator artery; and sometimes the joint receives a branch from both sources.

Peculiarities.—With few exceptions, the peculiarities met with in the internal circumflex branch depend upon its transference to the femoral artery, and, in almost all cases, to a point above the origin of the profunda artery [plate 72, fig. 5]. Examples have been also met with in which the internal circumflex arose from the epigastric [plate 74, figs. 1, 3], from the circumflex iliac [plate 74, fig. 5], or from the external iliac artery [fig. 2]. Peculiarities.

The *perforating* arteries (perforantes), *h* [plate 69], so called because they reach the back of the thigh by perforating the adductor brevis and adductor magnus muscles, are three or four in number. The *first perforating* artery passes backwards below the pectineus muscle, and through the fibres of the short and great adductor muscles; after which it immediately divides into branches [plates 76, 77], which are distributed to both adductor muscles, to the biceps, and great gluteal muscle, and communicate with the sciatic and internal circumflex arteries. The *second perforating* artery, considerably larger than the first, passes through the adductor brevis and magnus; after which it divides into ascending and descending branches, which ramify in the hamstring muscles, and communicate with the other perforating branches: an offset of it, named the *nutrient artery* of the femur, enters the medullary foramen of that bone. The *third perforating* artery pierces the adductor magnus, and, like the others, is distributed to the long flexor muscles at the back of the thigh, anastomosing with the other perforating arteries above, and with the termination of the profunda artery itself below.

Perforating branches; first, second. Nutrient artery of femur. Third perforating.

On the back of the limb all the perforating arteries, after supplying the offsets above noted, wind round the femur, and end in the vastus muscle on the outer part of the thigh. Ending in thigh.

Termination of the deep femoral artery.—After having given off these different branches, the deep femoral artery becomes considerably diminished in size, and passing backwards close to the linea aspera, divides into smaller branches, some of which are distributed to the short head of the biceps, the rest to the other hamstring muscles. Ending of the deep femoral;

These ultimate branches of the deep femoral artery communicate with those of the popliteal artery, and with the lower perforating arteries already described.

as a fourth perforating artery. The perforating arteries present no peculiarities of note. The terminal branch of the deep femoral, already described, is sometimes regarded as a *fourth perforating* artery.

MUSCULAR BRANCHES.

Muscular branches. In its course along the thigh, the femoral artery gives off several branches to the contiguous muscles. They vary in number from two to seven. They supply the sartorius and the vastus internus, with other muscles which are close to the femoral artery: their size appears to bear an inverse proportion to that of the descending branches of the external circumflex artery.

ANASTOMOTIC ARTERY.

Anastomotic artery. Close to its termination the femoral artery gives off a branch, constant but of small size, named the *anastomotic artery* (*anastomotica magna*), fig. 151, *i* [plate 78, fig. 3], which descends in the same line as the femoral artery itself. Course. Arising from that vessel when about to enter the popliteal space, it descends upon the tendon of the adductor magnus to the inner condyle of the femur, giving off several branches, and covered by some of the fibres of the vastus internus muscle; it finally anastomoses with the superior internal articular artery, and with the recurrent branch of the anterior tibial artery. Branches. Superficial and deep. Of its branches a superficial one accompanies the saphenous nerve beneath the sartorius muscle to the integument on the inner side of the knee; and others pass obliquely outwards through the substance of the vastus internus, and communicate with the descending muscular branches in front of the thigh. From the lower part of the vessel a branch crosses over the femur, supplies offsets to the knee-joint, and forms an arch a little above the articular surface, by anastomosing with the superior external articular artery.

The anastomotic artery varies not unfrequently in size, and in the point at which it arises.

POPLITEAL ARTERY.

The popliteal artery, fig. 152, A, [plate 78, fig. 4,] placed at the back of the knee-joint, extends along the lower third of the thigh and the upper part of the leg, reaching from the opening in the great adductor to the lower border of the popliteus muscle. It is continuous above with the femoral, and divides at the lower end into the anterior and posterior tibial arteries. Popliteal artery;

Fig. 152.*

This artery at first inclines from the inner side of the limb to reach the middle of the knee-joint, and thence continues vertically to its lower end. Lying deeply in its whole course, it is covered for some distance at its upper end by the semi-membranosus muscle ; lower down, a little above the knee, it is placed in the inter-muscular interval named the popliteal space, where it is covered by the fascia, and overlaid by the muscles which bound that space. The lower part of the artery is covered for a considerable distance by the gastrocnemius muscle, and at its termination by the upper margin of the soleus muscle. its course and position with respect to muscles;

At first this artery lies close to the inner side of the femur ; in descending, the vessel gets behind the bone, and as this is here curved forwards, while the course of the artery is straight, there is an interval between the two [plate 78, fig. 3]. The popliteal artery then rests against the posterior ligament of the knee-joint, and afterwards on the popliteus muscle. to bone.

Veins.—The popliteal vein lies close to the artery, behind and somewhat to the outer side till near its termination, where it crosses the Veins.

* Back of the knee and leg, showing the arteries. A. Popliteal. B. Anterior tibial. C. Posterior tibial. D. Peroneal. *a.* Sural arteries. *b*, *b*. Upper articular arteries. *c*, *c*. Lower articular. *d*. Anterior, and *e*. posterior branch of peroneal.

artery and is placed on the inner side. The vein is frequently double along the lower part of the artery, and, more rarely, also at the upper part [plate 80, fig. 2]. The short saphenous vein, ascending into the popliteal space over the gastrocnemius muscle, approaches the artery as it is about to terminate in the popliteal vein.

Nerve.

Nerve.—The inner division of the sciatic nerve lies at first to the outer side of the artery, but much nearer to the surface than the vessel : the nerve afterwards crosses over the artery, and is placed to the inner side below the joint [plate 81, fig. 2].

Arises prematurely;

Peculiarities.—Deviations from the ordinary condition of the popliteal artery are not frequently met with. The principal departure from the ordinary arrangement consists in its premature division into terminal branches. Such an early division has been found to take place most frequently opposite the flexure of the knee-joint, and not higher [plate 79].

divides into unusual branches.

In a few instances, the popliteal artery has been seen to divide into the anterior tibial and peroneal arteries—the posterior tibial being small or absent [plate 84, figs. 2, 3]. In a single case, the popliteal artery was found to furnish from its end three terminal vessels, like the chief artery of the upper limb, viz. the peroneal artery, as well as the two usual branches,—anterior and posterior tibials [plate 79, fig. 6].

Branches of popliteal artery.

Branches.—The popliteal artery gives off five articular branches, two above and two below the joint, and one which passes forwards into it ; also some large muscular branches to the hamstring muscles, and to the gastrocnemius.

MUSCULAR BRANCHES.

The muscular branches may be divided into a superior and an inferior set.

Superior muscular,

The *superior* branches, three or four in number, arise from the upper part of the popliteal artery, and are distributed to the lower ends of the flexor muscles of the knee, reaching also to the vasti muscles. They anastomose with the lower perforating arteries, with the terminal branches of the deep femoral artery, and with some of the articular arteries.

inferior, or sural arteries.

The *inferior muscular* branches, or *sural* arteries, (surales, fig. 152, *a*,) [plate 81, fig. 2,] usually two in number, and of considerable size, arise from the back of the popliteal artery, opposite the knee-joint, and enter, one the outer and the other the inner head of the gastrocnemius muscle, which

they supply, as well as the fleshy part of the plantaris muscle.

Over the surface of the gastrocnemius will be found at each side, and in the middle of the limb, slender branches, which descend a considerable distance along the calf of the leg, and end in the integument. These small vessels arise separately from the popliteal artery, or from some of its branches [plate 77]. Small cutaneous branches over calf of leg.

ARTICULAR ARTERIES.

The articular arteries [plate 79, fig. 1].—Two of these pass off nearly at right angles from the popliteal artery, one to each side, above the flexure of the joint, whilst two have a similar arrangement below it ; hence they are named the *upper internal* and *external*, and the *lower internal* and *external*. Besides these, there is a fifth articular artery, called the *middle articular*, because it enters the centre of the joint. Articular arteries.

The *upper articular arteries*, fig. 152, *b*, *b*.—That of the *inner side* turns over the femur just above the condyle ; and, passing under the tendon of the great adductor and the vastus internus, divides into two branches. Of these, one, comparatively superficial, enters the substance of the vastus, which it supplies, and inosculates with the anastomotic branch of the femoral, and with the lower internal articular artery. The other branch runs close to the femur, ramifies upon it, and also on the knee-joint, and communicates with the upper external articular artery. Upper internal.

The *upper external* articular artery passes outwards a little above the outer condyle of the femur, under cover of the biceps muscle, and, after perforating the intermuscular septum, divides into a superficial and a deep branch. The latter, lying close upon the femur, spreads branches upon it and the articulation, and communicates with the preceding vessel, with the anastomotic of the femoral, and with the lower external articular artery ; the superficial branch descends through the vastus to the patella, anastomosing with other branches and assisting in the supply of the joint. Upper external.

The *lower articular arteries*, *c*, *c* ; fig. 153, *c*, *d*.—The *internal* artery passes downwards below the corresponding tuberosity of the tibia, lying between the bone and the internal lateral ligament ; its branches ramify on the Lower internal.

front and inner part of the joint, as far as the patella and its ligament.

Lower external.

The *external* artery takes its course outwards, under cover of the outer head of the gastrocnemius in the first instance, and afterwards under the external lateral ligament of the knee and the tendon of the biceps muscle, passing above the head of the fibula. Having reached the fore part of the joint, it divides near the patella into branches, some of which communicate with the lower articular artery of the opposite side, and with the recurrent branch from the anterior tibial; whilst others ascend, and anastomose with the upper articular arteries.

In this manner the four articular branches form at the front and sides of the knee-joint a network of vessels.

Middle articular or azygos artery.

The remaining articular artery, called, from its position, the *middle articular*, and, from its being a single vessel, *azygos*, is a small branch which arises from the popliteal artery, opposite the flexure of the joint. It pierces the posterior ligament, and supplies the crucial ligaments and the other structures within the articulation. This small artery frequently arises from one of the other articular branches, especially from the upper and external branch.

POSTERIOR TIBIAL ARTERY.

Posterior tibial artery.

The posterior tibial artery [plates 81, 83] is situate along the back part of the leg, between the superficial and deep layers of muscles, being firmly bound down to the latter by the deep fascia.

Extent.

This artery, fig. 152, c, extends from the lower border of the popliteus muscle, where it is continuous with the popliteal artery, down to the inner surface of the calcaneum, where it terminates beneath the origin of the abductor pollicis muscle by dividing into the external and internal plantar arteries.

Course.

Placed at its origin at equal distances between the two sides of the limb, and opposite to the interval between the tibia and fibula, it approaches the inner side of the leg as it descends, and lies behind the tibia; at its lower end it is placed midway between the inner malleolus and the prominence of the heel. Very deeply seated at the upper part, where it is covered by the fleshy portion of the gastrocnemius and soleus muscles, it becomes comparatively super-

Connections in leg with muscles and fascia;

ficial towards the lower part, being covered only by the integument and two layers of fascia, and by the annular ligament behind the inner malleolus. In front, the artery rests successively against the tibialis posticus, the flexor longus digitorum, and, at its lower end, directly on the tibia and the ankle-joint.—The posterior tibial artery is accompanied by two veins [plate 83, fig. 1]. The posterior tibial nerve is at first on the inner side of the artery, but in the greater part of its course the nerve is close to the outer side of the vessel. With veins.

Behind the inner ankle, the tendons of the tibialis posticus and flexor longus digitorum lie between the artery and the malleolus; whilst the tendon of the flexor longus pollicis is to its outer side. Connections behind ankle.

Peculiarities.—When the popliteal artery divides prematurely, as already described, (p. 356), the posterior tibial, as well as the anterior tibial, is necessarily longer than usual [plate 79]. In some of these cases, it has been observed that the posterior tibial artery does not give origin to the peroneal [fig. 5]. Peculiarities in length.

Size.—The posterior tibial artery is not unfrequently diminished in size in different degrees; this deficiency being compensated for by an enlarged peroneal artery in the leg, or by the anterior tibial artery in the foot. See the account of these arteries respectively. Size.

The posterior tibial is sometimes absent; in which case the peroneal is enlarged, and takes its place from above the ankle downwards into the sole of the foot [plate 84, fig. 3]. Absence.

The posterior tibial artery furnishes numerous small *branches*; and besides these, one large branch, named the peroneal artery, which will be presently described. Branches.

Several *muscular* branches arise from this artery in its course along the leg, and are distributed principally to the deep-seated muscles in its neighbourhood, besides one or two of considerable size to the inner part of the soleus muscle. Muscular.

The *nutrient artery* of the tibia, which is the largest of its kind in the body, arises from the posterior tibial artery near the commencement, and, after giving small branches to the muscles, enters the nutrient foramen in the bone, and ramifies on the medullary membrane. This vessel not unfrequently arises from the anterior tibial artery. Nutrient to the bone.

A *communicating* branch from the peroneal artery joins the posterior tibial about two inches above the ankle-joint. Communicating.

PERONEAL ARTERY.

Peroneal artery; The peroneal artery, fig. 152, D, [plates 81, 83,] lies deeply along the back part of the leg, close to the fibula: hence its names, peroneal and fibular. Arising from the posterior tibial artery about an inch below the lower border of the popliteus muscle, it inclines at first obliquely towards the fibula, and then descends nearly perpendicularly along that bone and behind the outer ankle, to reach the side of the os calcis. In the upper part of its course, this artery is covered by the soleus muscle and the deep fascia, and afterwards by the flexor longus pollicis which is placed over the artery as far as the outer malleolus; below this point, the vessel is covered only by the common integument and the fascia. The peroneal artery rests at first against the upper part of the tibialis posticus muscle, and afterwards in the greater part of its course, it is surrounded by fibres of the flexor longus pollicis, lying close under a projecting ridge of the fibula.

connections with other parts;

in a hollow between interosseous ligament and bone.

Peroneal ends on os calcis. Above the malleolus the artery furnishes an offset to the front of the leg; and descending beyond the outer malleolus it terminates by giving off a series of branches, which ramify on the outer surface of the os calcis. These anastomose with the external malleolar and with the tarsal arteries on the outer side of the foot; and behind the os calcis with ramifications of the posterior tibial artery [plate 83, fig. 2].

Veins. Two veins accompany the artery.

Branches. Muscular. *Branches.*—The upper part of the peroneal artery gives numerous *muscular* branches to the soleus, the tibialis posticus, the flexor longus pollicis, and the peronei muscles, the largest branches being those to the soleus. It likewise furnishes a *nutrient* artery to the fibula.

Nutrient artery to fibula.

Anterior peroneal. *Anterior peroneal artery*, fig. 152, *d*, fig. 154, *m* [plates 81, 83].—This arises about two inches above the outer malleolus, and immediately pierces the interosseous membrane to reach the fore part of the leg. It then descends along the front of the fibula, covered by the peroneus tertius muscle, and dividing into branches, reaches the outer ankle, and anastomoses with the external malleolar branch of the anterior tibial artery. It supplies vessels to the ankle-joint, and ramifies on the front and outer side of the tarsus, inosculating more or less freely with the tarsal arteries.

Communicating branch to posterior tibial artery.—Lying close behind the tibia, about two inches from its lower end, a transverse branch will be found connecting the peroneal with the posterior tibial artery, and seeming, by its direction, to pass from the former to the latter vessel. Branch to posterior tibial.

Peculiarities.—The peroneal artery presents occasional deviations from its ordinary condition, in regard to its place of origin, its size, and the extent of its distribution. Peculiarities.

This artery has been found to arise lower down than usual, about three inches below the popliteus muscle; and, on the contrary, it sometime commences higher up from the posterior tibial, or even from the popliteal artery itself [plate 79, figs. 2, 6]. in origin;

When the popliteal artery divides prematurely, the peroneal artery is, in some cases, transferred to the anterior tibial [plate 79, fig. 5]. from anterior tibial.

Variations in its *size* constitute the most frequent peculiarities to which the peroneal artery is liable. It more frequently exceeds than falls short of the ordinary dimensions. Size.

When larger than usual, it is often found to reinforce a small posterior tibial, either by a transverse vessel which joins the diminished artery in the lower part of the leg [plate 84, fig. 2]; or two such reinforcing vessels may be present, one crossing close to the bone, and one over the deep muscles. But the occurrence of a second communicating branch is rare. Again, a large peroneal artery has been observed to take the place of the posterior tibial at the lower part of the leg, and thence onwards to the foot; the last-named vessel, in such cases, existing only as a short muscular branch at the upper part of the leg [plate 84, fig. 3]. Is large;

The anterior division of the peroneal artery (anterior peroneal) has in some cases more than its ordinary size, and compensates for a small anterior tibial artery in the lower part of the leg [plate 85, fig. 4], or supplies the place of that artery on the dorsum of the foot [fig. 5]. anterior division enlarged.

The peroneal artery is rarely smaller than usual. When only its anterior division is wanting, a branch of the anterior tibial supplies the deficiency; but when the decrease is carried so far that the peroneal artery is expended before reaching the lower part of the leg, a branch of the posterior tibial supplies its place on the outer side of the foot [plate 84, fig. 4]. Rarely below its usual size.

In one singular case, recorded by Otto, the peroneal artery was wholly wanting.* Wanting.

PLANTAR ARTERIES.

Terminal branches of the posterior tibial artery.—When the tibial artery reaches the hollow of the calcaneum, and gets beneath the origin of the abductor pollicis, it divides into the two *plantar* arteries, which are named internal and external from their position. Plantar arteries.

* "Neues Verzeichniss der Anatomischen Sammlung," &c. Prep. 2093.

Internal plantar; small size.

The *internal plantar* artery, fig. 153, *a*, [plate 86,] much smaller than the other, is directed forwards, along the inner side of the foot. Placed at first (in the position of the foot during the erect posture) above the abductor pollicis, and afterwards between it and the short flexor of the toes, it gives branches to both ; and also some offsets which incline towards the inner border of the foot, and communicate with branches of the dorsal arteries. On reaching the extremity of the first metatarsal bone, the internal plantar artery, considerably diminished in size, terminates by running along the inner border of the great toe, anastomosing with the digital branches. The direction of the artery corresponds with that of the line which separates the internal from the middle set of plantar muscles.

Fig. 153.

External plantar;

The *external plantar* artery, *b*, [plate 86,] much larger than the internal plantar, at first inclines outwards and then forwards, to reach the base of the fifth metatarsal bone : thence, changing its direction, it turns obliquely inwards across the foot, to gain the interval between the bases of the first and second metatarsal bones, where it joins, by a communicating branch, with the dorsal artery of the foot ; and thus the plantar arch is completed, the convexity of which is turned forward. In this long course the vessel lies at different degrees of depth. At first it is placed, together with the external plantar nerve, between the calcaneum and the abductor pollicis ; then between the flexor brevis digitorum and flexor accessorius. As it turns forwards it lies comparatively near the surface in the interval between the short flexor of the toes and the abductor of the little toe, being placed along the line separating the middle from the external portion of the plantar fascia ; by which membrane, and by the integuments and fat, the vessel is here covered. The remainder of the artery, which turns inwards and forms the plantar arch, is placed deeply against the interosseous muscles, and is covered by the flexors of the toes and the lumbricales muscles.

course; forms the plantar arch.

From the plantar arch numerous *branches* are given off, varying in size and importance. Of these, some run outwards over the border of the foot, and anastomose with the dorsal arteries; others go back to supply the parts in the hollow of the foot; and several pass to the fascia, integument, and subcutaneous superficial fascia. These branches are too irregular to admit of being named or described. Branches; many unimportant.

From its upper and fore part branches are given off which require particular notice.

The *posterior perforating* branches, *d*, three in number, pass upwards through the back part of the three outer interosseous spaces, between the heads of the dorsal interosseous muscles. On reaching the dorsum of the foot, these small vessels inosculate with the interosseous arteries,—branches of the metatarsal artery. Posterior perforating.

The *digital* branches, four in number, are named from the order in which they arise from the arch, counting from without inwards, first, second, third, and fourth digital arteries. The *first* digital branch inclines outwards from the outermost part of the plantar arch, opposite the end of the fourth metatarsal space, to gain the outer border of the little toe. In this course the vessel crosses under the abductor muscle of that toe, and then runs along the outer border of the phalanges, on the last of which it terminates. The *second* digital branch passes forwards along the fourth metatarsal space, and behind the cleft between the fourth and fifth toes divides into two vessels, which course along the contiguous borders of those toes, and end on the last phalanges. The *third* digital branch is similarly disposed of on the fourth and third toes. And the *fourth* ends in like manner on the third and second toes. Digital arteries; first, second, third, and fourth.

Near its point of bifurcation, each digital artery sends upwards through the fore part of the corresponding metatarsal space a small branch, *anterior perforating*, which communicates with the digital branch of the metatarsal artery. Anterior perforating.

The digital arteries of each toe, which, from their relation to the phalanges, are sometimes called collateral, incline towards each other at their termination, and inosculate near the base of the last phalanx, so as to form an arch, from the convexity of which minute vessels pass forwards to the extremity of the toe, and to the matrix of the nail. In this, the ordinary arrangement of the vessel, both sides of the three outer toes, and one side of the second toe, are Ending on the toes.

supplied by branches derived from the plantar arch ; whilst both the collateral arteries of the great toe, and the inner one of the second, are furnished, as will presently appear, by the dorsal artery of the foot.

Peculiarities.

Peculiarities of the plantar arteries.—Some of these will be considered after the description of the anterior tibial artery and its branches in the foot. It may be stated here, however, that the posterior perforating branches, which are usually very small vessels, are sometimes enlarged, and furnish the interosseous arteries on the upper surface of the foot; the metatarsal branch of the dorsal artery, from which the interosseous arteries are usually derived, being in such cases very small.

ANTERIOR TIBIAL ARTERY.

Anterior tibial;

The anterior tibial artery, fig. 154, A, [plate 82], placed along the fore part of the leg, is at first deeply seated, but gradually approaches nearer to the surface, as it descends.

extent;

It extends from the division of the popliteal artery to the bend of the ankle ; whence it is afterwards prolonged to the interval between the first and second metatarsal bones, under the name of *dorsal artery* of the foot.

course;

The anterior tibial artery is at first directed forwards to reach the fore part of the interosseous ligament ; and this short part of the vessel passes through the forked upper end of the tibialis posticus, and through the interval between the bones left unoccupied by the interosseous ligament. Having reached the fore part of the leg, the artery extends obliquely downwards to the middle of the ankle-joint, so that its course may be nearly indicated by a line drawn from the inner side of the head of the fibula to midway between the two malleoli.

connections with muscles;

Lying between the tibialis anticus on its inner side, and the extensor communis digitorum, with, lower down, the extensor proprius pollicis on its outer side, the vessel is deeply placed at the upper part of the leg, where those muscles are fleshy ; but is comparatively superficial below, where the muscular fibres have ended in the tendons. At the bend of the ankle it is covered by the annular ligament, and is crossed by the tendon of the extensor proprius pollicis. In its oblique course downwards the anterior tibial artery rests at first

interosseous ligament and bone.

against the interosseous ligament, and is then at a considerable distance from the spine of the tibia ; but in descending it gradually approaches that ridge, and towards

the lower part of the leg is supported on the anterior surface of the bone.

Veins.

The anterior tibial artery is accompanied by two veins (venæ comites). The anterior tibial nerve, coming from the outer side of the head of the fibula, approaches the artery at some distance after the appearance of the vessel in front of the interosseous ligament. Lower down, the nerve for the most part lies in front of the artery, but often changes its position from the one side of the vessel to the other.

Nerve.

Fig. 154.*

Branches.

Branches.—The branches of the anterior tibial artery are small but very numerous, and are given off at short intervals along the parent vessel. Most of them are distributed to the neighbouring muscles, and are unnamed. The following named branches require special notice.

Muscular.

Recurrent tibial artery.

The *recurrent artery*, fig. 154, *e* [plate 79, fig. 1].—On reaching the front of the leg, the anterior tibial artery sends upwards a considerable branch, which, from its course, is thus named. This branch ascends through the fibres of the tibialis anticus, and, ramifying on the lateral and fore parts of the knee-joint, anastomoses with the inferior articular branches of the popliteal artery.

Malleolar arteries;

The *malleolar arteries*, *f*, *g* [plate 84, fig. 1]. — Near the ankle-joint two branches, named internal and external malleolar, are given off by the anterior tibial artery. The *internal* branch, having passed beneath the tendon of the tibialis anticus, reaches the inner ankle, and ramifies upon it, supplying the surrounding textures, and communicating with branches of the posterior tibial artery. The *external malleolar* branch bears a similar relation to the outer ankle;

inner;

outer.

* A sketch showing arteries in front of leg and foot. A. Anterior tibial. B. Dorsal artery of foot. *c*, *d*. Articular arteries. *e*. Recurrent artery. *f*, *g*. Malleolar. *h*. Tarsal. *i*. Metatarsal. *k*. Dorsalis pollicis.

having passed under the tendon of the common extensor of the toes, it anastomoses with the anterior division of the peroneal artery, and also with some ascending or reflected branches from the tarsal branch of the dorsal artery of the foot.—These malleolar arteries supply articular branches to the neighbouring joints.

It should be further remarked, that these branches vary frequently in their mode of origin and in their size.

DORSAL ARTERY OF THE FOOT.

Dorsal artery of foot; The dorsal artery of the foot (dorsalis pedis), fig. 154, B, [plate 83, 84], the continuation of the anterior tibial artery, extends from the termination of that vessel at the bend of the ankle, to the posterior end of the first metatarsal space. At this spot it divides into two branches, of which one proceeds forwards in the first interosseous space, whilst the other dips into the sole of the foot, and terminates by inosculating with the plantar arch. This vessel, in its course, course forwards, rests upon the astragalus, the scaphoid and internal cuneiform bones, and their respective articulations. It lies in the interval between the tendon of the proper extensor of the great toe, and that of the long connections. extensor of the other toes; and is covered by the fascia of the foot besides the integument, and by a deeper layer of fascia, which binds it to the parts beneath. Near its end it is crossed by the innermost tendon of the short extensor of the toes.

Vein and nerve. Two veins accompany this artery; the anterior tibial nerve lies on its outer side.

Branches. The *principal branches* of the dorsal artery of the foot are directed outwards and forwards upon the tarsus and metatarsus, and are named accordingly. Some small offsets also run obliquely inwards, and ramify upon the inner side of the foot.

Tarsal artery. The *tarsal* branch [plate 84, fig. 1], fig. 154, *h*, arises from the artery usually where it crosses the scaphoid bone, but its point of origin varies in different instances. It inclines forwards and outwards upon the tarsal bones covered by the short extensor muscle of the toes, to which, and to the tarsal articulations, it gives small vessels. The tarsal artery, then curving backwards towards the cuboid bone, divides into branches which take different directions: some of them

run forwards, to anastomose with the divisions of the metatarsal artery ; others outwards, to communicate at the outer border of the foot with branches of the external plantar artery ; whilst a third set anastomoses with branches of the external malleolar, and with those of the peroneal artery upon the outside of the calcaneum.

The *metatarsal* artery [plate 84, fig. 1], *i*, arises farther forwards than the preceding vessel, and is directed outwards like it, beneath the short extensor muscle. Sometimes there are two metatarsal arteries, the second being of smaller size ; and not unfrequently, when there is but a single vessel of this name, it arises in common with the tarsal artery. Its direction is necessarily influenced by these circumstances; being oblique when it arises far back, and almost transverse when its origin is situate farther forwards than usual. Branches pass off in different directions for the supply of the surrounding structures; some of these run outwards and anastomose with offsets from the external plantar artery, whilst others curve backwards to join with those of the tarsal artery. Only its interosseous branches require to be specially noticed :— **Metatarsal artery ;**

The *interosseous* branches, three in number, are so named from their position between the metatarsal bones. They are small straight vessels which pass forwards from the metatarsal artery, along the three outer interosseous spaces, resting upon the dorsal interosseous muscles. Somewhat behind the clefts between the toes each interosseous artery divides into two branches, which run forwards along the contiguous borders of the corresponding toes, forming their dorsal collateral branches. Moreover, from the outermost of these interosseous arteries a small branch is given off, which gains the outer border of the little toe, and forms its external collateral branch. Hence it appears, that the interosseous branches derived from the metatarsal artery supply the dorsal surface of the three outer toes, and that of one side of the second toe. **three interosseous arteries.**

As these vessels bifurcate opposite the fore part of the interosseous spaces, they communicate with the plantar artery by means of the *anterior perforating* branches ; and at the back part of the interosseous spaces, they are likewise joined by the *posterior perforating* branches of the same artery.

First interosseous branch (dorsal artery of the great toe : dorsalis pollicis).—When the dorsal artery of the foot **Another interosseous artery.**

having passed under the tendon of the common extensor of the toes, it anastomoses with the anterior division of the peroneal artery, and also with some ascending or reflected branches from the tarsal branch of the dorsal artery of the foot.—These malleolar arteries supply articular branches to the neighbouring joints.

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Vein and nerve. Two veins accompany this artery; the anterior tibial nerve lies on its outer side.

Branches. The *principal branches* of the dorsal artery of the foot are directed outwards and forwards upon the tarsus and metatarsus, and are named accordingly. Some small offsets also run obliquely inwards, and ramify upon the inner side of the foot.

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run forwards, to anastomose with the divisions of the metatarsal artery; others outwards, to communicate at the outer border of the foot with branches of the external plantar artery; whilst a third set anastomoses with branches of the external malleolar, and with those of the peroneal artery upon the outside of the calcaneum.

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The *interosseous* branches, three in number, are so named from their position between the metatarsal bones. They are small straight vessels which pass forwards from the metatarsal artery, along the three outer interosseous spaces, resting upon the dorsal interosseous muscles. Somewhat behind the clefts between the toes each interosseous artery divides into two branches, which run forwards along the contiguous borders of the corresponding toes, forming their dorsal collateral branches. Moreover, from the outermost of these interosseous arteries a small branch is given off, which gains the outer border of the little toe, and forms its external collateral branch. Hence it appears, that the interosseous branches derived from the metatarsal artery supply the dorsal surface of the three outer toes, and that of one side of the second toe. three interosseous arteries.

As these vessels bifurcate opposite the fore part of the interosseous spaces, they communicate with the plantar artery by means of the *anterior perforating* branches; and at the back part of the interosseous spaces, they are likewise joined by the *posterior perforating* branches of the same artery.

First interosseous branch (dorsal artery of the great toe: dorsalis pollicis).—When the dorsal artery of the foot Another interosseous artery.

has reached the first metatarsal space, it gives off this branch, *k*, which runs along the outer surface of the first metatarsal bone, and is analogous to the other interosseous arteries. On reaching the fissure between the first and second toes, this branch divides into two smaller vessels, which run along the contiguous borders of these two toes on their dorsal surface.

Ending of the artery.

After having furnished this branch, the *dorsal artery* of the foot dips into the first interosseous space between the heads of the first dorsal interosseous muscle, and inosculates with the end of the external plantar artery, so as to complete the plantar arch.

Digital branch to great toe and second toe.

Digital branches.—At this point it gives off two branches. One of these crosses beneath the first metatarsal bone, and runs along the inner side of the great toe on its plantar surface. The other is directed forwards opposite the first metatarsal space, and divides into two smaller branches, which proceed along the contiguous sides of the great and the second toe.—In this way the series of digital arteries for the supply of the under surface of the toes is rendered complete [plate 86, fig. 3].

Peculiarities in place of origin;

Peculiarities of the anterior tibial.—The peculiarities of this artery relate to its origin, its course, its size, and the condition of its branches.

Origin.—In cases of premature division of the popliteal artery, the place of origin of the anterior tibial is necessarily higher up than usual, being sometimes found as high as the bend of the knee-joint. In some of these cases (the posterior tibial artery being small or wanting), the anterior tibial is conjoined with the peroneal artery. When the anterior tibial arose higher than usual, the additional upper part of the vessel has been seen resting on the popliteus muscle [plate 79, fig. 3], and it has been likewise found between that muscle and the bone [fig. 4].

in course;

Course.—The anterior tibial, having its usual place of origin, has been found to deviate outwards towards the margin of the fibula in its course along the front of the leg, and then to return to its ordinary position beneath the annular ligament in front of the ankle-joint [plate 85, figs. 2, 3]. This artery has been also noticed by Pelletan * and by Velpeau † to approach the surface at the middle of the leg, and to continue downwards from that point, covered only by the fascia and integument.

close under fascia;

The last-named observer states that he found the artery reach the fore part of the leg by passing round the outer side of the fibula. ‡

in size.

Size.—This vessel more frequently undergoes a diminution than an increase of size.

It may be defective in various degrees. Thus, the dorsal branch of

* "Clinique Chirurgicale," &c., p. 101. Paris, 1810.

† "Nouveaux Elémens de Médecine Opératoire," &c.; t. i. p. 137 Paris, 1837.

‡ Op. cit. p. 537.

the foot may fail to give off digital branches to the great and second toes, which [as in fig. 4, plate 86] may be then derived from the internal plantar (a branch of the posterior tibial). In a farther degree of diminution the anterior tibial ends in front of the ankle [plate 85, fig. 4], or at the lower part of the leg [fig. 5]; its place being then taken by the anterior division of the peroneal artery, which supplies the dorsal artery of the foot; the two vessels (anterior tibial and anterior peroneal) being either connected together [fig. 4], or separate [fig. 5].

Two cases are mentioned by Allan Burns, in which the anterior tibial artery was altogether wanting, its place in the leg being supplied by perforating branches from the posterior tibial artery, and on the dorsum of the foot by the anterior division of the peroneal artery. Absence of artery.

The dorsal artery of the foot is occasionally larger than usual; in that case compensating for a defective plantar branch from the posterior tibial artery [plate 86, fig. 5]. Dorsal artery of foot large;

This artery has been repeatedly found to be curved outwards between its commencement at the lower border of the annular ligament and its termination at the first interosseous space [plate 85, fig. 4]. curved.

VARIATIONS OF THE ARTERIES OF THE LEG AND FOOT CONSIDERED COLLECTIVELY.

From the facts above mentioned, concerning the peculiarities of the three arteries which supply the leg and foot, it will be apparent that all the deviations from the ordinary arrangement, in regard to their size, display a general principle of compensation, by which deficiencies in one vessel are balanced by an increase in the size of another. One artery takes place of another;

It will be also perceived, that, whilst the anterior and posterior tibial arteries have a greater tendency to diminish than to increase in size, the peroneal artery, on the contrary, is the vessel which is the most frequently enlarged. The anterior and posterior tibials, however, occasionally assist each other, especially in the supply of arteries to the toes. peroneal the compensating artery.

ANASTOMOSES OF ARTERIES IN THE LOWER LIMB.

Frequent mention has been made of the anastomoses which exist between the branches of the arteries in the lower limb; and a general view of them may be now taken, in order that some idea may be formed of the important influence which they exert in maintaining the circulation of the limb, when the principal artery is obliterated by an operation, or by disease. Anastomoses of arteries.

It may be remarked, in the first place, that the more important of these anastomoses occur in the neighbourhood of the principal articulations of the limb. Thus, it will be remembered that branches from different directions converge

Opposite hip-joint; towards the back part of the *hip-joint.* The circumflex arteries (internal and external) turn round the shaft of the femur, one from within, the other from without; the gluteal and sciatic arteries run from above downwards, and the superior perforating branches of the deep femoral from below upwards, towards the same point. At the anterior and upper part of the limb, a similar mode of connection occurs, but by no means so extensive, between the ilio-lumbar and the circumflex iliac artery; and again between the latter vessel and the external circumflex on the one hand, and the epigastric artery on the other.

knee-joint; Around the *knee-joint* a very free communication exists between the four articular arteries converging to its fore part; the recurrent tibial coming from below; and the anastomotic artery and the descending branches of the external circumflex, from the opposite direction. This anastomosis is connected with that in the neighbourhood of the hip-joint by the descending branches of the external circumflex artery in front, and by the series of perforating branches of the deep femoral artery and some muscular branches of the popliteal artery behind.

ankle-joint. Lastly, the *ankle-joint* is likewise surrounded by a series of anastomotic vessels. Thus, the posterior tibial and the peroneal arteries communicate across the limb before they proceed to their final destination. In front of the joint, the anterior peroneal branch anastomoses with the external malleolar and with the tarsal arteries: the external malleolar artery communicates again with the peroneal; whilst the internal malleolar maintains a similar connection with the posterior tibial artery or its branches.

VEINS.

THE veins are those vessels through which the blood returns from the capillaries to the heart. They admit of being arranged into two distinct classes: viz., the *systemic veins*, which convey the dark or impure blood from all parts of the body back to the right auricle of the heart; and the *pulmonary veins*, by which the re-oxygenated or red blood is carried from the lungs to the left auricle of the heart. Veins are systemic or pulmonary.

The *pulmonary* veins, a distinct set of vessels from the bronchial veins, or veins concerned in the nutrition of the lungs, serve a special use connected with respiration, and will be described with the anatomy of the respiratory organs.

The *systemic* veins, which are now to be considered, commence in the capillary vessels of all parts of the body by means of small branches, which, uniting into fewer and larger branches and anastomosing freely with each other, end for the most part in two large venous trunks—the upper and lower venæ cavæ—which empty their contents into the right auricle of the heart. The veins from the wall of the heart itself open at once into the cavity of the right auricle. General characters of systemic veins.

There is, however, one set of systemic veins, (those of the chylopoietic viscera,) the large branches of which do not tend directly to the heart or to one of its great veins. Thus, the veins of the stomach, intestines, pancreas, and spleen, unite into a single large trunk, which again branches out in the manner of an artery within the liver, and ends in a capillary system in the substance of that gland. This large venous trunk is the *portal vein* (vena portæ); and the branches of which it is composed, with those into which it divides within the liver, constitute the *portal system* of veins. Portal vein, and portal system of veins.

Other veins, named *hepatic*, commencing in the capillaries of the liver, and resembling in their arrangement the Hepatic veins.

systemic veins generally, convey the blood to the lower vena cava, and thence to the heart.

Veins subcutaneous and deep.

The veins of many parts of the body consist of a subcutaneous and a deep set, which have very frequent communications with each other. In some parts of the body, to be mentioned particularly hereafter, the veins are provided with valves, whilst in others no valves exist.

Valves.

Three groups of veins;

The systemic veins may be arranged and described in certain groups, according to their mode of termination in the heart.

connected with upper vena cava;

a. In the first group are included the various branches of the *upper vena cava*, viz., those of the head, neck, upper limbs, and walls of the thorax. With this part of the venous system the cerebro-spinal veins may be also arranged; and the azygos veins (great and small) belong to this upper group of veins, and serve to connect it with the next or lower set.

with lower cava;

b. The second group of veins consist of those which end in the lower vena cava. They are derived from the lower limbs, and from the lower part of the trunk—the *portal system* being considered as an adjunct.

veins of heart.

c. Lastly, the veins from the substance of the heart open directly into the right auricle, and are therefore not connected with either of the sets of veins ending in the two venæ cavæ.

VEINS OF THE HEAD, FACE, AND NECK.

Veins of head and face

The veins of the head are divided, like the arteries, into two sets,—those which ramify on its exterior, and those placed in its interior. The latter, or cerebral veins and sinuses, will be presently described. The veins of the head and neck have generally no valves. The external jugular vein is provided with a valve at its entrance into the subclavian vein, and in most cases with another about the middle of its course: and the internal jugular is also furnished with valves near its junction with the subclavian. These valves, however, are not efficient in stopping the regurgitation of the blood, or the passage of injections from below upwards.

generally have no valves.

The veins on the exterior of the head and face converge and unite, so as to form two trunks, the facial and the temporal veins.

THE FACIAL VEIN.

The *facial* vein, fig. 155, *a*, lies obliquely along the side of the face, extending from the inner margin of the orbit downwards and outwards to the anterior border of the masseter muscle. Resting on the same plane as the facial artery, but farther back, and less tortuous, it has very Facial vein; its course;

Fig. 155.

nearly the same connections with parts around. It may be said to commence at the side of the root of the nose by a vein formed by the junction of branches from the forehead, eyebrow, and nose; and to increase by receiving others during its course. how formed.

The *frontal* vein commences on the roof of the skull by branches, which descend obliquely inwards upon the forehead, maintaining communications in their course with the anterior branches of the temporal vein. By gradually converging, these branches form a vein of some size, which descends vertically, parallel with the corresponding vessel of the opposite side, with which it is connected by trans- Frontal vein;

verse branches. In some instances the veins of the two sides unite and form a short trunk, which again divides into two branches at the root of the nose. These branches diverge as they run along the sides of the nose at its root, where each becomes continuous with the corresponding angular vein. As it descends from the forehead, the frontal vein receives a branch from the eyebrow, and some, of smaller size, from the nose and upper eyelid.

supra-orbital, The *supra-orbital* vein (v. supercilii) runs inwards in the direction of the eyebrow, covered by the occipito-frontalis muscle. Its branches are connected externally with those of the external palpebral and superficial temporal veins; in its course it receives branches from the contiguous muscles and integument, and at the inner angle of the orbit inclines downwards to terminate in the frontal vein.

The supra-orbital and frontal veins, by their junction, angular, form the *angular vein*, which is perceptible beneath the skin as it runs obliquely downwards and outwards by the inner margin of the orbit, resting against the side of the nose at nasal, the root. This vessel receives by its inner side the *nasal veins*, which pass upwards obliquely to join it from the side and and palpebral veins; ridge of the nose; whilst some small *superior palpebral* veins open into it from the opposite direction. Opposite the lower margin of the orbit, the angular vein may be said to terminate by becoming continuous with the facial vein.

The *facial vein*, commencing as has been just stated, gradually increases, as it receives branches from the lower eyelid, from the ala of the nose, and from the upper lip. inferior palpebral, By its outer side it receives two or three veins—*inferior palpebral*, which are formed by small branches derived from the lower eyelid, from the outer side of the orbit, and from the cheek. The direction of these palpebral branches is obliquely inwards above the zygomatic muscle, beneath which they turn previously to their termination. On a level with the angle of the mouth, the facial vein receives communicating, *communicating* branches from the pterygoid plexus (deep facial, anterior internal maxillary); and also some branches proceeding from the orbit, furnished by the *infra-orbital* of the internal maxillary vein. In front, the facial vein is labial, buccal, and masseteric branches. farther increased by branches from the lips, *labial*, and behind by others from the cheek, *buccal*: still lower down, by branches from the masseter muscle, *masseteric*, on the one hand, and from the chin on the other. Having reached the base of the lower maxilla, the vein inclines outwards and

backwards, covered by the cervical fascia and the platysma muscle; and soon unites with a large branch of communication derived from the temporal vein, to form a vessel of considerable size, which joins obliquely the trunk of the internal jugular vein, *k*.

Previously to its termination, the facial vein receives the following branches: The *ranine* vein, a small vessel which lies along the under surface of the tongue, close by the frænum linguæ, is in apposition with the artery of the same name: its course is backwards and outwards, between the mylo-hyoid and hyo-glossus muscles, to open into the facial vein, or sometimes into the lingual. The *submental* vein, larger than the preceding, commences below the chin; it receives branches from the submaxillary gland, and from the mylo-hyoid muscle, and, keeping close under cover of the margin of the jaw-bone, joins the facial vein; but in some instances enters the lingual or superior thyroid vein. *Submaxillary* branches from the gland join the vein either separately or united into one trunk. The *palatine* vein returns the blood from the plexus around the tonsil and from the soft palate; it passes downwards, deeply seated by the side of the pharynx, to join one of the preceding veins, or terminate in the facial separately.

Ranine. submental, submaxillary, palatine, and tonsillar veins.

THE TEMPORAL VEIN.

The *temporal* vein, fig. 155, *b*, (vena temporalis,) a vessel of considerable size, descends in front of the external auditory tube, reaching from the zygoma, upon which it rests, to the angle of the jaw, and resulting from the union of branches which are spread out upon the side of the head, some being superficial, and others deeply seated. The superficial branches commence upon the arch of the skull, where they communicate with the ramifications of the frontal and occipital veins, as well as with those of the corresponding vein of the opposite side. Those from the fore part incline downwards, and a little backwards, whilst the posterior branches run forwards over the ear; all being placed between the skin and the temporal fascia. Converging in this way, they unite at an angle above the zygoma, and at their junction commences the trunk of the temporal vein. To the same point also passes a large branch, which may be called the *middle temporal* vein, to distinguish it from those which are still deeper seated and

Temporal vein. Superficial and middle temporal branches.

open into the internal maxillary vein. This vessel arises in the substance of the temporal muscle, from which the branches emerge, to form a vessel of some size upon the surface; it pierces the fascia at the upper border of the zygoma, and opens into the upper part of the common temporal trunk just alluded to. The temporal vein gradually sinks into the substance of the parotid gland as it descends behind the ramus of the jaw. Beneath the angle of that bone, it divides into two vessels, of which one, ordinarily the larger, inclines inwards to join with the facial vein, whilst the other turns backwards, and becomes continuous with the external jugular vein, *f*. The branches which open into the temporal vein in its course are numerous:—*parotid* branches, from the parotid gland; *articular*, from the articulation of the jaw; *anterior auricular* veins, from the external ear; and a vein of considerable size, the *transverse facial*, from the side of the face. This last-named vessel, *c*, corresponds with the transverse artery of the face: it courses backwards from the side of the face to the temporal vein. From the opposite direction the temporal vein receives the *posterior auricular*, *d*, which is itself joined by the *stylo-mastoid* vein.

Temporal vein in parotid gland.

Parotid, articular, auricular, and transverse facial.

Posterior auricular. Stylo-mastoid.

Besides these, a branch of considerable size joins the temporal vein in the substance of the parotid gland; this is the *internal maxillary* vein, fig. 155, *e*. It corresponds somewhat in direction and position with the artery of the same name, and receives branches from the neighbouring parts, which are the venæ comites of the divisions of the internal maxillary artery. Thus three or four *deep temporal* branches descend from the temporal muscle; others come from the pterygoid, masseter, and buccinator muscles. The middle *meningeal* veins and some *palatine* veins also end in the internal maxillary; and lastly, branches from the surface of the upper jaw, and, of large size, from the lower jaw, emerging from the dental foramen—*inferior dental*. These different branches form a plexus of veins, named *pterygoid plexus*, which is placed in the lower part of the temporal fossa, between the temporal and the external pterygoid muscle, and in part between the pterygoid muscles. It communicates in front with the facial vein, and above, with the cavernous sinus by branches through the base of the skull. From this plexus proceed one or two short trunks, which join nearly at right angles with the temporal vein.

Internal maxillary vein.

Deep temporal,

middle meningeal and palatine.

Inferior dental.

The vessel formed by the junction of these different veins from the temple, maxilla, and face, may be called the *temporo-maxillary* vein; it descends in the interval between the ramus of the jaw and the sterno-mastoid muscle, and terminates in the external jugular vein, *f*, or partly in it and partly in the internal jugular vein. Temporo-maxillary or temporo-facial.

THE EXTERNAL JUGULAR VEIN.

The external jugular vein, fig. 155, *f*, commences on a level with the angle of the lower maxilla, at the end of the temporo-maxillary vein, and therefore receives the greater part of the blood returned from the face and the outside of the cranium. The external jugular vein descends perpendicularly between the platysma and fascia, crossing the sterno-mastoid muscle. In consequence of the oblique direction of the last-named muscle, the vein gets to its outer border, and continues behind it down to the lower part of the neck, where it pierces the fascia to terminate either as a single trunk, or by two or three branches, in the subclavian vein, *m*. In this course it receives one or two large branches from the back of the neck; one of these, *g*, *posterior external jugular*, lying at first between the splenius and trapezius, passes down at the outside of the jugular vein, and below the middle of the neck opens into it. Superficial branches also join it from the fore part of the neck. Some of these commence over the submaxillary gland, and some under the chin; by converging, they often form a vein of considerable size, *h*, which is then called the *anterior jugular* vein. This vessel lies along the fore part of the neck, sometimes near the sterno-mastoid muscle, and terminates either by inclining outwards to join the external jugular vein, or, after giving to it a branch of communication, sinks beneath the sterno-mastoid muscle, and ends in the subclavian vein. Previously to the termination of the external jugular vein, two large veins open into it, derived from the region of the scapula, *i*, *supra-scapular* and *posterior scapular:* their direction is transverse from without inwards, lying parallel with the arteries of the same name. External jugular; its course. Posterior jugular and anterior jugular branches. Veins from scapula.

As already mentioned, the external jugular vein is usually provided with two valves. Valves.

INTERNAL JUGULAR VEIN.

Internal jugular, The *internal jugular* vein, fig. 155, *k*.—The blood from the brain and cranial cavity is received by the internal jugular veins, which are continuous at their upper extremities with the lateral sinuses, whilst inferiorly they terminate in the innominate or brachio-cephalic veins. The commencement of each internal jugular vein at the lateral sinus is at the broad part (*jugular fossa*) of the foramen jugulare. sinus of; This part of the vessel, being somewhat enlarged, has been named the *sinus*, or *gulf* of the internal jugular vein. Beneath the skull, the vein is supported by the rectus lateralis muscle, and lies close to the outer side of the internal carotid artery, as far as the cornu of the os hyoides.

is joined by branch from temporal and by facial vein; Being joined at this point by the common trunk formed by the union of the facial with a part of the temporal vein, the internal jugular vein becomes considerably enlarged, and then descends parallel with the common carotid artery, lying at its outer side and enclosed in the same sheath, together with the vagus nerve. At the root of the neck it joins nearly at a right angle with the subclavian vein, and so forms the innominate or brachio-cephalic vein. Close valves. to the lower termination of the jugular, or from half an inch to an inch above it, are placed two valves as in other veins.*

Other branches, Previously to its junction with the facial vein, the internal jugular receives branches from the tongue, the pharynx, and the occiput: these branches, however, or some of them, are very frequently found to end in the common trunk of lingual, the temporal and facial veins. The *lingual* vein begins at the side and upper surface of the tongue, and passes backwards, receiving branches from the sublingual gland; occasionally the ranine vein joins it, and sometimes also the pharyngeal. In either case it passes backwards to open pharyngeal, into the internal jugular vein. The *pharyngeal* vein commences at the back and sides of the pharynx, and sometimes ends in the superior thyroid vein, and sometimes in the lingual, or separately in the internal jugular vein.

occipital, Corresponding in course and distribution with the occipital

* Dr. Struthers directs attention to these valves, which are readily seen on slitting down the jugular vein. (Anatomical and Physiological Observations). See also the foot-note to p. 383, respecting valves in the subclavian vein.

artery there is an *occipital* vein, which communicates with a plexus of veins upon the occiput, and terminates occasionally in the external jugular vein, but more frequently in the internal.

The *laryngeal* vein receives branches from the larynx through the thyro-hyoid membrane; they unite and form one vein, which opens into the internal jugular, or into the temporo-maxillary venous trunk, or sometimes into the superior thyroid vein. Laryngeal,

The *superior thyroid* vein commences by branches in the thyroid body, in company with those of the superior thyroid artery. These unite and form a single vessel, which runs transversely outwards, and opens into the internal jugular vein. Lower down is found another branch—*middle thyroid*, also derived from the thyroid body. superior thyroid, and middle thyroid veins.

VEINS OF THE UPPER LIMB.

The veins of the upper limb are divisible into two sets, one being superficial, the other deep-seated. Both these sets of veins, as high up as the axillary, and including that vein, are provided with valves, which are more numerous in the deep than in the subcutaneous veins. Valves are constantly to be found at the entrance of branches into the main vessels. Veins of upper limb have valves.

THE SUPERFICIAL VEINS.—These are much the larger, and lie between the skin and fascia. Commencing on the dorsal surface of the fingers, they converge and communicate with one another on the back of the hand, so as to form a sort of plexus, from which issue two chief veins, that take, one the radial, the other the ulnar border of the fore arm. Subcutaneous veins.

The *radial cutaneous* vein, fig. 156, *a*.—The radial cutaneous vein commences by branches upon the dorsal surface of the thumb and fore finger. These ascend over the outer border of the wrist, and form by their union a large vessel, which passes along the radial border of the fore arm, receiving numerous branches from the anterior and posterior surfaces. At the bend of the arm it receives a branch from the median vein, (median-cephalic,) and then continues its course at the outer side of the upper arm, and is named "cephalic" vein. Radial veins.

The *cephalic* vein, *b*, thus formed, ascends along the outer Cephalic vein.

border of the biceps muscle, and then in the interval between the great pectoral and deltoid muscles, and finally terminates in the axillary vein, between the coracoid process and the clavicle.

Fig. 156.

Ulnar cutaneous, The *ulnar cutaneous veins.*—There are two ulnar cutaneous veins, one on the front, the other on the back part of the fore arm. posterior, The *posterior* ulnar cutaneous vein, *d*, begins on the back of the hand by branches, which unite to form a vein placed over the fourth metacarpal space, and called by some of the older anatomists "vena salvatella." This proceeds along the ulnar border of the fore arm at the posterior aspect, and, somewhat below the bend of the elbow, turns forwards to join with the anterior ulnar cutaneous vein. anterio The *anterior* ulnar cutaneous vein, *c*, commences upon the anterior surface of the wrist, and thence ascends along the fore arm, communicating by branches with the median vein on the one hand, and with the posterior ulnar cutaneous on the other. From the bend of the elbow upwards, the trunk formed by the union of the two ulnar cutaneous veins with a branch of the median assumes the name of "basilic vein."

Basilic. The *basilic* vein, *e*, is usually of considerable size; it receives at its origin a branch from the median vein, *g*, (median-basilic,) and ascending along the inner border of the biceps muscle, in front of the brachial artery, terminates in one of the venæ comites of that vessel, or in the axillary vein which it chiefly forms.

Median-cutaneous; The *median-cutaneous* vein, *f*, results from the union, on the anterior part of the fore arm, of several branches. It is a short trunk, which serves as a means of communication between the ulnar and radial cutaneous veins on each side, as well as between the superficial and deep veins of the arm. Its length is subject to many varieties; it terminates near the bend of the elbow by dividing into two branches, which diverge upwards from each other. One of these, inclining

inwards to join the basilic vein, and thence named *median-basilic*, *g*, passes in front of the brachial artery, from which it is separated by the fibrous expansion given by the tendon of the biceps muscle to the fascia covering the flexor muscles; it is crossed by branches of the internal cutaneous nerve: the other division, *h*, *median-cephalic*, directed outwards, unites with the cephalic vein, branches of the external cutaneous nerve crossing behind this vein. The upper part of the median vein is also connected with the deep veins by a short branch, which sinks beneath the fascia and joins the veins accompanying the brachial artery. median-basilic; median-cephalic.

THE DEEP VEINS OF THE UPPER LIMB.—The brachial artery, its immediate branches, and their several divisions, are each accompanied by two veins, named *venæ comites*. These companion veins lie one on each side of the corresponding artery, and are connected with each other at intervals by short cross branches, which in some places surround the artery. Deep veins. Companion veins;

The *deep ulnar veins*, or the *companion veins* of the ulnar artery.—On examining the hand, it will be found that two small *digital* veins accompany each digital artery along the side of the phalanges. At the clefts between the fingers, the two small veins from each finger are united into single trunks, which continue along the interosseous spaces in the palm of the hand, and terminate in the two *superficial palmar* veins. From this double venous arch two branches proceed at the inner side of the wrist, and accompany the ulnar artery: sometimes small external branches follow the course of the superficial volar artery. The two deep *ulnar* veins, commencing thus at the inner side of the superficial palmar arch, pass in front of the wrist, where they communicate with the interosseous and the superficial veins; then proceeding upwards along the inner side of the fore arm, one on each side of the ulnar artery, they receive several branches from the neighbouring muscles; and, lastly, being joined by the veins which accompany the interosseous and ulnar recurrent arteries, unite with the deep radial veins to form the venæ comites of the brachial artery. digital, palmar, ulnar.

The *interosseous veins* consist of two sets (anterior and posterior), corresponding to the arteries with which they are associated. The *anterior* interosseous veins commence in front of the wrist-joint, where they communicate freely Inter-osseous anterior,

with the deep radial and ulnar veins. In their course upwards they are joined by several small branches, and are connected at the upper part of the fore arm with the posterior veins by means of branches which pass through the interosseous membrane near the elbow-joint; after being joined by the posterior interosseous veins, they end in the venæ comites of the ulnar artery. The veins which accompany the *posterior interosseous* artery, previously to passing from behind to join the anterior veins, communicate by their smaller branches with the ulnar cutaneous veins, and through branches accompanying the recurrent interosseous artery, with the cephalic vein.

posterior.

Radial.

The small branches which unite to form the *deep radial* veins run along the interosseous muscles in the palm of the hand; they are united in front with the digital veins previously described, and, at each end of the interosseous spaces, are connected by perforating branches with small veins situate on the back of the hand; by uniting across the bases of the metacarpal bones, they form a double venous arch corresponding with that formed by the radial artery. These *deep palmar* veins communicate on the inner side with the superficial arch of veins, and on the outer side end in the companion veins of the radial artery. The deep radial veins, in passing upwards to the fore arm, receive at the wrist a dorsal branch, and one which passes over the small muscles of the thumb, with the superficial volar artery; then pursuing the course of the radial artery, they are joined by small veins from the surrounding parts, and end in the venæ comites of the brachial artery.

Deep palmar.

Brachial.

The two *brachial* veins, resulting from the union of the deep ulnar and radial veins just described, follow, like the several vessels of the same kind, the course of the artery with which they are associated. They are joined in their progress from the bend of the elbow upwards on the arm, by the veins which accompany the branches of the brachial artery, namely, the anastomotic and the two profunda arteries of the arm. At the lower margin of the subscapularis muscle, the brachial veins join the axillary; not unfrequently, however, one of them will be found to come forwards and unite with the basilic, which soon becomes then continuous with the axillary vein.

Ending.

Anastomoses of deep veins;

Between the several veins of the upper limb hitherto described, numerous communications exist in their whole course. Thus, those which lie beneath the integument are

connected to each other by branches in the hand and fore arm. Each pair of companion veins is also united by short transverse vessels crossing the artery which they accompany, whilst between those attending different arteries frequent connections exist. Lastly, as has been in many instances specially indicated, the subcutaneous and the deep veins communicate freely, especially in the neighbourhood of joints. This general anastomosis ensures the continuance of the circulation, during muscular action, in the frequent and varied motions of the limb.

one with another;

with subcutaneous veins.

AXILLARY VEIN.

The *axillary vein* extends, like the corresponding artery, from the lower border of the axilla to the outer margin of the first rib; it is covered by the pectoral muscles and the costo-coracoid membrane, and is placed to the inner side of the axillary artery. It is continuous below with the basilic vein of the arm, either alone or in conjunction with one of the deep brachial veins. The branches which open into the axillary vein are very numerous: it receives the subcutaneous veins of the arm—the basilic at its commencement, the cephalic towards its termination, and between these, the companion veins of the brachial artery; it is also joined by the several veins corresponding with the branches of the axillary artery, viz., the two *circumflex* and the *subscapular* veins from the shoulder, the *alar* vein from the axilla, and the inferior, the superior, and acromial *thoracic* veins from the side of the chest. The axillary vein, therefore, returns all the blood from the upper limb: its size is very considerable, and it is the highest of the veins of the upper limb in which valves are constantly found.

Axillary vein;

branches like those of artery;

has valves.

SUBCLAVIAN VEIN.

The *subclavian vein*, fig. 157, *d*, is the continuation of the axillary, but is not like it constantly provided with valves.* It extends from the outer margin of the first rib to the inner

Subclavian vein;

* Anatomists state commonly that the subclavian vein wants valves. Dr. Struthers, referring to the valves in the jugular, says:—"We have found valves also in the trunk of the subclavian vein, near to its termination in the innominate, and we are not sure but that in the instances in which we met with one only, the other had been destroyed in slitting the vein."—Anatomical and Physiological Observations, p. 173. By John Struthers, M.D. Edin. 1854.

end of the clavicle, behind which it is joined by the internal jugular vein, *c*, the union forming the innominate or brachio-cephalic vein, *e*. The subclavian vein crosses over the first rib, and behind the clavicle, not reaching so high up in the neck as the subclavian artery; it is covered by the clavicle, and by the subclavius and sterno-mastoid muscles, and lies on a plane anterior to the artery, from which, while resting on the rib, it is separated by the scalenus anticus muscle and the phrenic nerve.

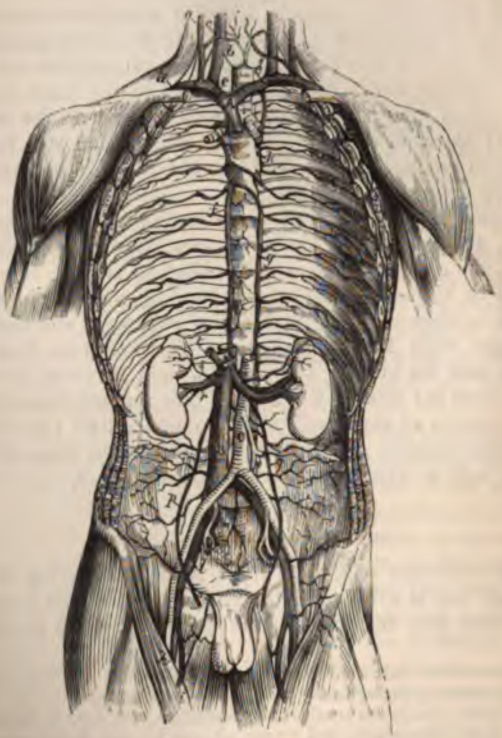
course,

and connections.

Branches.

Branches.—On the outer side of the last-named muscle it

Fig. 157.



receives the external and anterior jugular veins, and on the inner side the internal jugular. In their course to join

the subclavian vein both jugular vessels pass in front of the subclavian artery, and add to the difficulty of placing a ligature on that vessel. The subclavian vein receives also the following branch.

The *vertebral vein*, commencing in branches which proceed from the pericranium and the deep muscles lying behind the foramen magnum of the occipital bone, passes outwards and downwards to reach the intertransverse foramen of the atlas. Through this foramen, and through the canal formed by the corresponding foramina of the other cervical vertebræ, the vein descends with the vertebral artery. Emerging at the foramen in the sixth vertebra, it runs forwards and downwards to join the subclavian vein close to the termination: a small branch sometimes descends through the foramen in the seventh vertebra, and opens separately into the same vein. The vertebral vein is joined in its course by several branches from the neighbouring muscles; also, immediately before its termination, by a branch corresponding with the deep cervical artery; and in the same situation by another branch of considerable size, which descends in front of the bodies and transverse processes of the vertebræ of the neck. It communicates frequently with the spinal veins in the neck, with both those on the outer side, and those in the interior of the spinal canal.

Vertebral vein

lies with artery.

Branches to it.

INNOMINATE OR BRACHIO-CEPHALIC VEIN.

The blood returned from the upper limbs through the subclavian veins, and from the head and neck by the jugular veins, is poured into two trunks, which are therefore named *brachio-cephalic*. These vessels, fig. 157, *e*, *e*, (called also *innominate*, from their relation to the innominate arteries,) resulting from the union of the subclavian with the internal jugular vein at each side, commence opposite the inner ends of the clavicles, and terminate a little below the cartilage of the first rib on the right side, where, by uniting, they form the upper vena cava, A. In consequence of the situation of the point at which they meet, the right and left veins differ considerably in direction, length, and connections. That of the right side is very short, and nearly vertical in its direction; this vein is in apposition, on the right side, with the pleura and the upper part of the right lung. The vein of the left side, about three times longer than the preceding, is

Brachio cephalic or innominate veins;

differ on two sides: in length;

connections;

directed across from left to right, at the same time inclining somewhat downwards: it crosses behind the first bone of the sternum, separated from it by the sterno-hyoid and sterno-thyroid muscles, and by the thymus gland or its remains; it lies in front of the three primary branches given off from the arch of the aorta, and rests upon the highest part of the arch. The innominate veins have no valves. Their branches are the following:—

No valves.

Inferior thyroid.

The *inferior thyroid* veins emerge from a sort of venous plexus on the thyroid body—those of opposite sides communicating by small branches across the trachea. The vein of the left side descends in front of the trachea, behind the sterno-thyroid muscles, and ends in the left brachio-cephalic or innominate vein: that of the right side inclines outwards in some degree, and opens into the corresponding brachio-cephalic vein, or into the angle of union between it and the vessel of the opposite side.

Internal mammary.

The *internal mammary* veins follow exactly the course of the arteries of the same name—two veins accompanying each branch of the arteries. The two companion veins of the artery arise by small branches, derived from the fore part of the walls of the abdomen, where they anastomose with the epigastric veins; from thence proceeding upwards behind the cartilages of the ribs between them and the pleura, they receive the *anterior intercostal* veins which correspond with the branches of the internal mammary artery, together with some small *diaphragmatic*, *thymic*, and *mediastinal* veins, and finally, after uniting into a single trunk, terminate in the brachio-cephalic veins, each on its own side.

Branches; anterior intercostals; phrenic, mediastinal, &c.

Superior intercostal.

The *superior intercostal* veins.—The right superior intercostal receives the blood from the first or the first two spaces, communicating with the vessel in the space next below, and opens into the innominate trunk of the same side, or into the vena cava. Sometimes the veins at the right side, corresponding with the superior intercostal artery, pass downwards separately, to open into the azygos vein, as that vessel arches forwards to join the upper vena cava: when they unite to form a separate vein, its size is much inferior to that on the left side. The *left* superior intercostal vein, fig. 157, *h*, varies in length in different persons, being small when the azygos minor is large, and *vice versâ*. Usually it receives the veins from the two or three upper spaces, and is then directed forwards over the left side of the spinal column and the aorta to open into the left innominate vein. It receives

Right.

Ending.

Left.

Origin.

in its course the left bronchial vein. The left vein is sometimes directed downwards to join an azygos vein on its own side. Ending; in an azygos vein.

UPPER VENA CAVA.

The *upper vena cava*, fig. 157, A, conveys to the heart the blood which is returned from the head, the neck, the upper limbs, and the thorax. It extends from a little below the cartilage of the first rib on the right side of the sternum to the base of the heart, where it opens into the right auricle. Its course is slightly curved, the convexity of the curve being turned to the right side. It has no valves. At about an inch and a half above its termination, it is invested by the fibrous layer of the pericardium, the serous membrane being reflected over it. The upper cava lies immediately in front of the right pulmonary vessels, and between the right lung and the aorta, which partly overlap it. It receives several small veins from the pericardium and the mediastinum; and lastly, it is joined by the right azygos vein. Upper vena cava; extent and course; small branches.

In several instances, the two innominate veins, which usually join to form the vena cava superior, have been seen to open separately into the right auricle. Variation.

The innominate vein of the right side, in these cases, continues in the ordinary course of the vena cava; whilst the left vein, after sending a branch across to the other, descends to the left side of the heart, and ends in the back of the right auricle, with the coronary vein [plate 58, figs. 9 and 10]. Innominate veins not joining.

This arrangement of the veins is natural in the fœtus at a very early period, and is also met with as a permanent condition in birds and in certain mammalia. In the subsequent change from the two vessels in the human fœtus to one in the adult, the greater part of the left trunk is obliterated from the cross branch above mentioned downwards to the heart, where its end always remains pervious as the coronary sinus. Traces of the existence of the vessel can always be recognised: thus in the adult a fibrous band in the situation of it can be followed along the back of the left auricle; and in front of the root of the left lung there remains a small fold of the serous membrane of the pericardium, which Mr. Marshall names the *vestigial* fold of the pericardium.* This usual in fœtus; state in the adult. Remnant of the obliterated part.

AZYGOS VEINS.

The azygos veins are formed by the veins derived from those intercostal spaces to which arteries are furnished by Veins of the thorax;

* On the Development of the great Anterior Veins in Man and Mammalia, by John Marshall, F.R.C.S. Phil. Trans., part i. 1850.

right and left. the aorta. They are placed on the sides of the spine, one for the right, and one or two for the left half of the thorax. Above they are blended into one trunk, which opens into the upper cava.

Right azygos vein; The *right* azygos vein (v. sine pari).—The name given to this vein signifies that it has no fellow or corresponding vessel (α priv. ζευγνυμι); but it cannot be applied with propriety, inasmuch as there may be one or more similar though smaller vessels on the opposite side (azygos minor).

commencement; The azygos vein, fig. 157, *f*, commences sometimes by a small branch either from the inferior cava, where that vessel turns forwards to reach the aortic opening in the diaphragm; but much more frequently it begins below from the lumbar veins (ascending lumbar) of the right side, or sometimes from the renal vein.

course along bodies of vertebræ. Passing from the abdomen into the thorax through the aortic opening in the diaphragm, or to the outer side of that opening through the fibres of the diaphragm, the azygos vein ascends on the bodies of the dorsal vertebræ, until it arrives opposite the root of the right lung,

Ending. over which it arches forwards, and then opens into the upper vena cava, immediately above the point at which that vessel is invested by the pericardium.

Connections. When passing through the opening in the diaphragm, this vein is accompanied by the thoracic duct, both being situate on the right side of the aorta. In the thorax, maintaining the same position with respect to the duct and the œsophagus, it crosses in front of the intercostal arteries, and is covered by the pleura.

Receives lower intercostal veins. It is joined by the several veins which accompany the aortic intercostal arteries of the right side; and at about the sixth or seventh dorsal vertebra, by the left or smaller azygos vein of the opposite side. It is also joined by several œsophageal and other small veins, and near its termination by the bronchial vein of the right lung; and it is sometimes connected with the right superior intercostal vein.

Joins two cavæ. As it communicates below with the vena cava inferior by one of the branches of that large vein, while it terminates in the vena cava superior, it forms a connection between those two vessels.

Valves imperfect. A few valves of imperfect formation have been found in the azygos vein; its branches (intercostal veins) are provided with distinct valves.

The azygos vein has been seen to receive the lower vena cava, and, in such cases, is of course extremely large (see page 404).

In one instance, Meckel found the azygos ending in the subclavian vein.

On the left side of the chest the veins below the two or three highest spaces are usually divided between two trunks : the lowest and largest of these is the more constant, and is named the small azygos ; the other is the smallest of the three. Veins of the left side. Number.

The *left* lower or *small azygos* vein, fig. 162, *g*, commences from one of the lumbar veins (ascending lumbar), or from the left renal vein, and having entered the thorax with the aorta, or through the crus of the diaphragm, ascends upon the spine in front of the left intercostal arteries ; passing behind the aorta, it opens into the right azygos vein, opposite the sixth or seventh dorsal vertebra. It receives the lower intercostal veins of the left side. Small azygos or left lower. Termination.

The *left upper azygos* receives the veins between the third and the sixth spaces, and descends to end either in the left lower azygos, or separately in the trunk on the right side. It anastomoses with the veins above and below on its own side of the chest, viz. with the superior intercostal, and the lower or small azygos. If this vein is smaller than usual, or absent, the size of the upper intercostal vein will be increased so as to reach down sometimes as low as the fifth or sixth space. Left upper, ending, communications.

All the intercostal veins of the left side have been observed in some instances to join a single vein, which ended in the left innominate. This arrangement corresponded with that on the right side of the body.

The *bronchial veins* return the residue of the blood employed in the nutrition of the lungs. Their course is determined by that of the bronchi, which support them as they pass towards the root of the lungs. The bronchial vein of the right side opens into the trunk of the azygos vein near its termination, that of the opposite side ends in the superior intercostal vein. Bronchial veins.

VEINS OF THE SPINE AND CRANIUM.

The part of the venous system contained within the skull and spinal canal, presents certain peculiarities deserving especial notice. *In the cranium* are a series of sinuses, representing at once reservoirs and canals, interposed between the smaller venous branches and the large trunks (internal jugular) which transmit the circulating fluid towards the heart. The sinuses in the skull are formed General view. In skull, "sinuses ;"

between layers of the dura mater, their cavities being lined by a continuation of the internal membrane of the veins: they are very numerous, and vary considerably in form and size.

In spinal canal, plexuses of veins; Along the whole length of the *spinal canal* there is found a series of venous tubes or plexuses which present some resemblance to the cranial sinuses, but which may be regarded as intermediate in character between those sinuses and the veins in other parts of the body. The spinal veins have no

no valves. valves.

Spinal veins; arrangement of. The veins within and upon the spinal column may be distinguished into the following sets: *a.* Those placed deeply in the vertebral grooves, and resting upon the spines and arches of the vertebræ. *b.* The veins of the spinal cord itself. *c.* Veins lodged within the bodies of the vertebræ. *d.* Two long series of veins, or rather venous plexuses, extended behind the bodies of the vertebræ the whole length of the canal. *e.* Veins on the fore part of the arches of the vertebræ.—There are likewise branches of communication, some of which connect all the other sets together, and some which bring them into connection with the general venous system.

Preparation of the veins. *Preparation and Dissection.*—The long spinal veins were first described by Chaussier; the veins of the cranial and spinal bones, as well as of the osseous system generally, were subsequently examined with great care by Dupuytren, and demonstrated in his lectures on anatomy. Breschet subsequently took up the subject.* In order to inject those vessels, an old and emaciated body should be chosen, as the venous system becomes more developed in advanced age; it should be placed in a warm bath in the usual way, and be thoroughly heated previous to injection. As the vessels cannot be filled from any single vessel, advantage must be taken of their numerous communications to inject them from different points. With this view, an injecting pipe must be inserted into the upper longitudinal sinus, and others into the azygos vein, and the upper and lower venæ cavæ. Through all these vessels the fluid for injecting should be pushed, and through at least two or three of them, if possible, at the same time. The posterior and external veins (if the injection has succeeded) are to be traced through the mass of dorsal muscles; those within the spinal canal are best seen by making a vertical section of the spine and skull, dividing them into two lateral halves; or the arches of the vertebræ may be cut out, and the cavity exposed.

Dorsal veins; dorsi-spinales. *a.* The *dorsal veins* (dorsi-spinales,—Dupuytren, Breschet).—The blood from the muscles and integument placed along the back of the spine is returned by a series of short

* Essai sur les Veines du Rachis. 4to. Traité Anatomique sur le Système Veineux. Fol., avec planches.

veins, which ramify upon the arches and spinous processes of the vertebræ, and run forwards to terminate in some of the larger veins within the spinal canal. Commencing by small branches, they gradually increase in size as they run forwards close by the spinous processes; on reaching the interval between the arches of the vertebræ, they pierce the ligamenta subflava, to terminate in a venous plexus within the canal. Towards the outer part of the intervertebral grooves another set of veins arise, which pass obliquely forwards, through the intertransverse spaces, in company with the posterior branches of the lumbar and intercostal arteries, and open into the veins which accompany those vessels.

b.—The *veins of the spinal cord* (medulli-spinales,—Breschet) ramify upon the cord and its nerves, enclosed within the sheath formed by the dura mater. Though they communicate with the other spinal veins, they are not injected with them, even when the injecting process above described is most successful. Breschet gives the following as the best method of demonstrating them: **Veins of cord; medulli-spinales.**

Preparation.—Let the injection consist of a strong solution of isinglass coloured with indigo or Prussian blue: open the spinal canal in the lumbar region, slit up the dura mater, and search for one of the largest of the veins which rest upon the cord; into this pass the point of a very small injecting pipe and then cautiously push the injection, for the coats of the veins are exceedingly thin and weak. **Preparation.**

The veins of the spinal cord are very small, long, and tortuous; they run upon both surfaces of the cord, where they form a diffused plexus or network. They become larger, for the most part, as they ascend, but near the base of the skull they are smaller than in the lumbar region. They communicate freely with the spinal veins and plexuses, by means of branches which accompany the nerves towards the intervertebral foramina. Near the base of the skull these veins unite, and form two or three small trunks, which communicate by transverse branches with the vertebral veins, and then terminate in the inferior cerebellar veins, or in the petrosal sinuses. **Disposition on the cord.**

c.—*The veins belonging to the bodies of the vertebræ* (venæ basis vertebrarum,—Dupuytren; veines basi-vertébrales,—Breschet) are comparatively large vessels contained in the canals within the bodies of the vertebræ; the arteries which may accompany them being very small. About the middle **Veins of vertebræ.**

of the posterior surface of each vertebra, (and this is especially evident in the dorsal and lumbar regions,) there is found a large foramen leading into a canal; this running forwards into the substance of the bone for two or three lines, divides into two smaller canals, which are directed towards each other, and often unite together. From this, still smaller canals pass obliquely forwards, some of which terminate in the cancelli of the bone, whilst others open upon the anterior or convex surface. Within these canals are situate the special veins of the bodies of the vertebræ. They anastomose on the front of the bones with some of the superficial veins; and the trunk of each, having reached the spinal canal, divides into two branches, which diverge and terminate in the large spinal veins behind the bodies of the vertebræ.

Great spinal veins;

d.—The blood collected by the different vessels here described is poured by them into two large veins, or rather tortuous venous canals, which extend, one on each side, along the whole length of the spinal canal behind the bodies of the vertebræ. These vessels may be named the *great spinal veins* (grandes veines rachidiennes longitudinales antérieures,—Breschet). They are not of uniform size throughout, but are alternately constricted and enlarged, the constricted points corresponding with the intervertebral foramina, where they are drawn forwards, and in a manner secured by the branches of communication which pass outwards. This long series of veins lies behind the bodies of the vertebræ, occupying the interval at each side between the intervertebral foramina and the orifices seen at the back of the bodies of those bones. In some parts the veins are double, or even triple, so as to form a plexus; and occasionally they are altogether interrupted, which shows that each portion may be regarded as a separate trunk, receiving blood and conveying it outwards into the general circulation, and that there is not necessarily an ascending or descending current along the venous column formed by the entire series of veins. In the thoracic region their communicating branches open into the intercostal veins, in the loins into the lumbar veins, in the neck for the most part into the vertebral.

their position within spinal canal;

form a plexus;

communicate with veins outside.

Posterior spinal veins, or plexuses;

e. The *posterior spinal veins* (veines longitudinales rachidiennes postérieures,—Breschet). Besides the anterior set of veins within the spinal canal, there is a complex interlacement of tortuous veins established along the inner or

anterior surface of the arches of the vertebræ. In the lower part of the canal this interlacement of veins is not so close as in the upper portion, where it usually conceals (if the injection has been successful) the whole surface of the dura mater. These veins converge to the intervertebral foramina, and join by rather small vessels with the intercostal veins. ending on outside;

From a consideration of the connection and arrangement of the different parts of these complex veins, it would appear that the blood in each part flows through them horizontally from behind forwards. The dorsal veins pour their blood into the longitudinal plexus on the inner surface of the arches of the vertebræ; thence it is collected by two or three small branches, which converge to the intervertebral foramina, and open into some of the veins outside the vertebral column in front, viz., into the lumbar, azygos, or cervical veins. Into these also, the contents of the great spinal veins are conveyed by the short communicating branches already noticed. apparent course of circulation.

CEREBRAL VEINS.

The part of the venous system contained within the skull consists of veins, properly so called, and of certain cavities or channels called sinuses. The veins which return the blood from the brain are divisible into two sets, one being on the surface, the other in the interior of that organ. Cerebral veins and sinuses. Veins;

The *superficial* veins ramify upon every part of the surface of the brain, receiving branches on the one hand from its substance, and terminating, on the other, in the different sinuses. Upon the upper surface of the hemispheres the veins will be seen for the most part to be lodged in the tortuous sulci between the convolutions; but some will be observed to run over the convexity of the convolutions. Their general direction is towards the middle line; and on reaching the margin of the longitudinal fissure between the hemispheres, they receive branches from the flat surface of the hemisphere, and, becoming invested by a tubular sheath of the arachnoid membrane, open obliquely forwards into the superior longitudinal sinus. superficial; surrounded by arachnoid; enter longitudinal

The veins upon the sides, and under surface of the brain, are similarly arranged; but are directed outwards, to open into the lateral and other sinuses at each side. and other sinuses.

Deep cerebral veins.

The *deep* veins of the brain commence by branches within the ventricles of that organ. Upon the surface of the corpus striatum, for example, several minute venous branches are seen, which for the most part converge, to form a slender vein which runs along the groove between the corpus striatum and optic thalamus, and opens into one of the veins of the choroid plexus. The minute *veins* of the *choroid plexus* pass backwards, and incline towards the middle line from each side, so as to form, by their union, two veins—

Venæ Galeni.

venæ Galeni. These, lying parallel, run directly backwards, enclosed within the velum interpositum, and escape from the ventricle by passing through the great transverse fissure of the brain between the under surface of the corpus callosum and the tubercula quadrigemina. In this way they reach the anterior margin of the tentorium cerebelli, at its place of union with the falx cerebri, where they terminate by opening into the straight sinus.

Veins of cerebellum.

The *veins of the cerebellum* are disposed in two sets, not merely from a reference to their position, but also from a consideration of their direction and termination. Those of the upper surface incline inwards and forwards for the most part, and will be found to run upon the upper vermiform process, over which they ascend a little to reach the straight sinus, in which they terminate; some, farther forwards, open into the veins of Galen. Those at the under surface run transversely outwards, and pour their contents into the occipital and the lateral sinuses.

CRANIAL SINUSES.

Cranial sinuses.

The sinuses placed within the cranial cavity are interposed between the cerebral veins and the internal jugular veins, which receive the blood from them. There are several of these canals, and, by reason of a difference in their position, they admit of being divided into two sets, viz., those placed in the prominent folds of the dura mater, and those disposed at the base of the skull.

The form and size of the sinuses are various. All of them are lined by a continuation of the internal membrane of the veins, the dura mater serving as a substitute for the external coat.

Sinuses contained

The sinuses which are contained in the several processes or folds of the dura mater converge to a common point,

which corresponds with the internal occipital protuberance, and is called the *confluence of the sinuses*, or *torcular Herophili*, fig. 158, *a*; fig. 159, *i*: its form is very irregular. If a square piece of bone be removed, and the dura mater be laid open at the point above referred to, six apertures leading to the following sinuses will be observed opening into it: viz., one to the longitudinal, and one to the straight sinus; two to the right and left lateral sinuses; and two to the posterior occipital sinuses. in dura mater. "Torcular Herophili."

The *superior longitudinal sinus*, fig. 158, *b* (sinus longitudinalis; s. falciformis superior) commencing at the crista Longitudinal sinus;

Fig. 158.

galli, extends from before backwards, in the upper border of the falx cerebri, gradually increasing in size as it proceeds. The cavity is triangular, and across the angle which is directed downwards several bands *chordæ Willisii* extend obliquely. The veins from the cerebral surface open into this sinus chiefly towards the back part; and in such a way that the apertures of the greater number of them are directed from behind forwards, contrary to the direction of the current within it. The longitudinal sinus communicates with the veins on the outside of the occipital bone, by a branch (one of the "emissary veins," Santorini) which passes through a hole in the parietal bone. traversed by chordæ Willisii. Opening of veins.

The *inferior longitudinal sinus*, fig. 158, *c* (s. falciformis inferior; sinus longitudinalis inferior) is very small. Its cavity is circular in form, and it so much resembles a Inferior longitudinal sinus.

vein, that it is sometimes named *inferior longitudinal vein.* Placed in the inferior concave border of the falx cerebri, it runs from before backwards, and opens into the straight sinus on reaching the anterior margin of the tentorium cerebelli. It receives branches from the surface of the falx cerebri, and sometimes from the flat surface of the hemispheres.

ranches.

Straight sinus.

The *straight sinus*, fig. 158, *d* (s. quartus ; s. tentorii).—This sinus might be considered as the continuation in direction of the inferior longitudinal sinus ; it runs backwards in the base of the falx cerebri, gradually widening as it approaches the torcular Herophili, in which it terminates. Its form is triangular ; some transverse bands cross its interior. Besides the inferior longitudinal sinus, the venæ Galeni, *e*, and the superior veins of the cerebellum, open into it.

Veins to it.

Lateral sinuses.

The *lateral sinuses*, fig. 158, *f* ; fig. 159, *h*, (sinus laterales ; s. transversi,) are of considerable size. Their direction conforms to that of the groove marked along the inner surface of the occipital and other bones, and extending from opposite the internal occipital protuberance to the foramen jugulare. The sinus of the right side is usually larger than that of the left ; both commence at the torcular Herophili, and terminate at the outlet just noticed, where they are continuous with the jugular veins. The lateral sinuses receive the blood transmitted from both the longitudinal sinuses, from the straight and occipital sinuses, from the veins upon the sides and base of the brain, from those on the under surface of the cerebellum, and from some of the veins of the diploë. The petrosal sinuses also join the lateral sinus on each side ; and two *emissary* veins connect these with the veins at the back of the head and neck.

Extent and ending.

Veins to it.

Emissary veins,

Posterior occipital sinus; one or two.

The *posterior occipital sinus*, fig. 158, *g* ; fig. 159, *g* (sinus occipitalis posterior), is sometimes a single canal, not unfrequently double, as if composed of two compartments. It lies along the attached border of the falx cerebelli, extending from the posterior margin of the foramen magnum to the confluence of the sinuses. It communicates in front with the posterior spinal plexuses of veins.

The sinuses placed at the base of the skull are as follows, taking them in their order from before backwards :

The *circular sinus*, fig. 159, *a* (sinus circularis,—Ridley). —The name expresses its form ; its position is round the margin of the pituitary fossa. It is not always a complete ring, as it represents sometimes a semicircle, placed usually before the gland, sometimes behind it. This small sinus receives the blood from the minute veins of the pituitary body. It communicates at each side with the cavernous sinus. Circular sinus. Use.

The *cavernous sinuses*, fig. 159, *b*, two in number, are placed one on each side of the body of the sphenoid bone. They are of a very irregular form, but of considerable size. Each receives the ophthalmic vein at its fore part, and communicates internally with the circular sinus, and posteriorly with the petrosal sinuses. At the side of the body of the sphenoid bone the dura mater divides into two layers ; one of these rests on the bone ; whilst the other is stretched from the margin of the sphenoidal fissure to the upper border of the petrous portion of the temporal bone ; so that the two layers leave an interval between them, constituting the sinus. In the thick outer layer of the dura mater are contained the following cranial nerves, the third, fourth, and ophthalmic trunk of the fifth. The membrane which lines the ophthalmic vein and the circular sinus, passes into the cavity now under consideration ; it is intimately connected with that layer of the dura mater which forms the inner wall of the sinus, but is separated from the outer wall by an interval in which are found the carotid artery and the sixth nerve. Cavernous sinus ; Nerves in the outer wall. Sinus contains carotid artery and sixth nerve.

The *upper petrosal sinus*, fig. 158, *h* ; fig. 159, *d*, is a narrow venous canal, running along the upper margin of the petrous part of the temporal bone. Commencing at the back part of the cavernous sinus, it is directed outwards and backwards in the attached margin of the tentorium cerebelli ; and descending a little, ends in the lateral sinus where this lies upon the temporal bone. Upper petrosal sinuses. Ending.

The *lower petrosal sinus*, fig. 158, *i* ; fig. 159, *e*, larger than the preceding sinus, is very near that sinus at its anterior end ; but is afterwards lower down, and to its inner side. Commencing at the cavernous sinus, the lower petrosal sinus passes downwards and backwards, taking the direction of the inferior margin of the petrous bone, between this and the basilar process of the occipital bone. It opens into the lateral sinus near the termination, or into the internal jugular vein. Lower petrosal sinus. Course. Ending.

Anterior occipital sinus.

The *anterior occipital* or *transverse sinus*, fig. 159, *f* (sinus basilaris).—This is placed at the fore part of the basilar process of the occipital bone, and reaches transversely, so as to establish a communication between the inferior petrosal and the cavernous sinuses.

Fig. 159.

OPHTHALMIC VEIN.

Ophthalmic vein

The ophthalmic vein, fig. 159, *c*, may be described with the veins of the cranium as it opens into the cavernous sinus. Its branches are distributed in the different structures contained within the orbit, in company with the branches of the ophthalmic artery: some small ramifications arise from the eyelids, whilst others communicate with the angular branch of the facial vein; and those which accompany the supraorbital artery have similar connections with the veins upon the forehead. All these branches, together with others arising from the lachrymal gland, from the different muscles, from the ethmoidal cells, from the globe of the eye itself,—all named according to the arterial branches which they accompany, join to form a short single trunk, which leaves the orbit by the inner part of the sphenoidal fissure, being placed between the heads of the external rectus, and terminates in the cavernous sinus.

communicates with angular vein.

Ending.

VEINS OF THE DIPLOË.

Veins of diploë lie in canals in cranial bones;

The veins of the cranial bones, veins of the diploë, are only to be seen after the pericranium is detached, and the external table of the skull carefully removed by the aid of a file. Lodged in canals hollowed in the substance of the bones, their branches form an irregular network, from which a few larger vessels issue. These are directed downwards at different parts of the cranium, and terminate, partly in the

veins on the outer surface of the bones, and partly in the sinuses at the base of the skull.

According to M. Breschet there are four such veins on each half of the cranium, viz. a frontal, occipital, and two temporal. are four on each side;

The *frontal*, placed as the name expresses, is very small, and issues by an aperture at the supraorbital notch to join the vein in that situation. frontal;

The *temporal* are distinguished as anterior and posterior. The anterior is contained chiefly in the frontal bone, and opens into the temporal vein, after escaping by an aperture in the great wing of the sphenoid. The other vein ramifies in the parietal bone, and passes through an aperture at the lower and hinder angle of the same bone to the lateral sinus. temporal; anterior, and posterior.

The *occipital* is the largest of all; and leaves the occipital bone opposite the inferior curved line to open either internally or externally—into the occipital sinus or the occipital vein. Its ramifications are confined especially to the occipital bone. Occipital.

VEINS FORMING THE LOWER VENA CAVA.

The branches which unite to form the lower vena cava return the blood from the lower limbs, and from the viscera of the pelvis and abdomen. Veins of lower limb;

The veins of the lower limb, as in other parts of the body, are divisible into two sets, of which one is deeply seated, whilst the other runs in the superficial fascia. All the veins of the lower limb, as high as the femoral venous trunk, are provided with valves, and these are said to be more numerous than in the veins of the upper limb. The deep veins have more valves than the subcutaneous set; and each branch has two valves placed to guard its entrance into a larger trunk. divided into two sets. Valves.

Superficial veins.—Immediately beneath the integument on the dorsum of the foot there exists a network of small veins, from which issue two principal trunks (saphenous), which are named, from their relative position, internal and external, or, from their relative length, the long and short. Subcutaneous veins.

The *internal* or *long saphenous* vein, fig. 160, extends from the ankle to within an inch and a half of Poupart's ligament; in this course it lies in the superficial fascia. Taking rise from the plexus of veins on the dorsum of the Long saphenous vein:

course; foot, it passes upwards in front of the inner ankle, and thence along the corresponding border

Fig. 160.

of the tibia, accompanied by the internal saphenous nerve. At the knee, the vein inclines a little backwards, as it passes by the inner condyle; after which it ascends along the inner and fore part of the thigh, and terminates in the femoral vein, after passing

perforates fascia lata.

through an aperture, 1, in the fascia lata, which, from this circumstance, has been termed the *saphenous opening*. It is joined in this long course by numerous cutaneous branches; and near

Its superficial branches;

its termination it receives the *superficial epigastric*, *a*; *external pudic*, *b*; and *superficial circumflex iliac vein*, *c*; the former passing down from the abdomen between the layers of the superficial fascia, the latter from the groin and pubes. In the leg it communicates with the deep veins accompanying the anterior and posterior tibial arteries, and in the thigh one or more branches pass between it and

Deep branches.

the femoral vein. This long vein has

Valves.

a variable number of valves. Sometimes six sets have been counted: in other cases only four, or even two. There are more in its course through the thigh than the leg.

Short saphenous vein;

The *external* or *short saphenous* vein proceeds from branches, *d*, which arise along the outer side of the dorsum of the foot, and passes behind the outer ankle, gradually inclining backwards to the tendo Achillis. Passing along the

course;

border of the tendon, it gets on the belly of the gastrocnemius muscle, fig. 161, on which it ascends, accompanied by the external saphenous nerve; with the nerve it runs between the heads of the gastrocnemius, and pours its contents into the popliteal

vein. Opposite the ankle and along the leg it joins the deep veins; and it receives superficial accessory veins from the outer part of the foot and the back of the leg. joins deep vein.

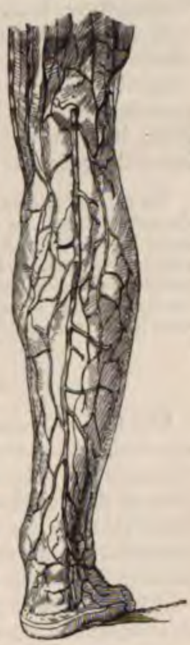
The DEEP VEINS of the lower limb accompany the arteries and their branches, following exactly their distribution. Those below the knee, being for the most part disposed in pairs, and presenting the disposition described in the corresponding veins of the upper limb, are named the *venæ comites* of the vessels with which they are associated. The venæ comites of the arteries of the leg, namely, the *anterior* and *posterior tibial veins* (the latter having previously received the *peroneal*), unite near the lower border of the popliteus muscle, and form by their junction the popliteal vein. The valves of the deep veins of the leg are very numerous,—ten or twelve sets being sometimes found between the heel and the knee.

Deep veins of lower limb; are companion veins.

Tibial. Peroneal; how end.

Valves.

Fig. 161.



The *popliteal vein*, thus formed, receives branches corresponding with the articular and muscular arteries; but its chief branch is the external saphenous vein. In its course through the ham, the popliteal vein is placed at first internal to the artery, then behind, and lastly to the outer side of it, that is to say, between it and the nerve. Thus situate, it passes up through the aperture in the adductor magnus, and becomes continuous with the femoral vein.

Popliteal.

Position to artery.

The union of the veins which form the popliteal is often delayed, and the lower part of the artery is accompanied by two veins. This arrangement in some rare cases extends to the entire length of the artery. ["The Arteries," &c., plate 80, fig. 2.] Popliteal double.

FEMORAL VEIN.

The femoral vein, fig. 157, *k*, extends, like the artery which it accompanies, through the upper two-thirds of the thigh. Placed at first outside that vessel, it gradually Femoral vein;

inclines inwards beneath it, so that on reaching Poupart's ligament (where it terminates in the iliac vein), it lies on the inner side, and on the same plane as the artery, being separated from it only by a slight partition which passes from before backwards across the membranous sheath investing them both. In the lower part of its course, the vein receives all the venous branches which accompany the offsets of the chief artery. In the upper part, the deep femoral vein opens into it, having first received all the branches from muscles supplied by the deep femoral artery. Near its termination the femoral vein is joined by the internal saphenous vein, fig. 157, *i*.

branches to it.

Varieties in course;

The femoral vein occasionally pursues a course different from that of the artery along the thigh. Extending upwards from the popliteal space, the vein in such cases perforates the adductor magnus above the ordinary position, and joining with the deep femoral vein first approaches the femoral artery at the groin. ["The Arteries," &c., plate 80, fig. 3]. The same vein is now and then double in a small part, or more rarely in almost its whole length. [Ibid. plate 75.]

may be double.

EXTERNAL ILIAC VEIN.

External iliac vein;

The femoral vein, placed at the inner side of the artery, enters the abdomen beneath Poupart's ligament, and assumes the name of external iliac vein, fig. 157, *l*. This vessel, lying at first on the same plane with, and afterwards to the inner side of the external iliac artery, gradually inclines somewhat behind the vessel on the right side in approaching the sacro-iliac articulation, where it joins the internal iliac vein to form the common iliac vein. Near its commencement at Poupart's ligament, the external iliac vein receives the circumflex iliac and epigastric veins. It does not possess valves.

position to artery;

no valves.

INTERNAL ILIAC VEIN.

Internal iliac vein;

The internal iliac vein, fig. 157, *m*.—All the branches of the internal iliac artery are accompanied by veins, except the umbilical whose corresponding vein is distributed in the fœtus to the liver: these several veins give rise to the internal iliac. The vessel thus formed lies behind the corresponding artery in front of the sacro-iliac articulation, and, after a very short course upwards to the margin of the pelvis, joins with the external iliac vein to form the common iliac. It returns the blood from the organs contained within the pelvis, and from the large mass of muscles which occupy the outer surface.

The branches of this vein follow the course of the arteries derived from the internal iliac artery, and, being remarkable for their size and their frequent anastomoses with each other, they have been described as forming a series of plexuses, severally named from the organs on which such interlacement occurs: thus the vesical and prostatic, hæmorrhoidal, uterine and vaginal plexuses, are described. No valves are found in the trunk of the internal iliac vein, but its branches are provided with them. its branches; no valves.

The *dorsal* vein of the *penis*, a vessel of considerable size, requires a special notice. Commencing by a series of branches which issue from the glans penis, there are in the first instance two, one at each side of the middle line, in the dorsal groove of the penis; they receive branches from the spongy bodies of the penis, and some superficial veins which accompany the external pudic arteries. Proceeding backwards, they unite and form a short trunk which enters the pelvis beneath the subpubic ligament. Here it divides into two branches, which are directed obliquely downwards over the prostate and the neck of the bladder, where they anastomose with branches of the vesical veins, forming a plexus, and finally open into the internal iliac vein. Dorsal vein of penis, joins vesical plexus.

COMMON ILIAC VEIN.

Each common iliac vein, formed by the confluence of the external and internal iliac veins, passes upwards; and the vein of the left side inclines towards the corresponding vessel of the opposite side. Near the junction of the fifth with the fourth lumbar vertebra, a little to the right of the middle line, the two common iliac veins unite to form the lower or ascending vena cava. The right vein is shorter than the left, and is nearly vertical in its direction. The right vein is placed behind, and then to the outer side of its artery; whilst the left vein is to the inner side of the left common iliac artery. Both pass behind the right common iliac artery.—These veins are destitute of valves. Common iliac vein; Differences in the two; no valves.

LOWER VENA CAVA.

The *lower vena cava* (vena cava inferior, ascendens), fig. 157, B, returns the residue of the blood circulated by the abdominal aorta. It commences at the junction of the two common iliac veins on the side of the fifth lumbar Lower vena cava;

vertebra, and thence ascends along the right side of the aorta, as far as the posterior border of the liver; it there becomes lodged in a groove in that organ, after which it inclines forwards to reach the opening in the diaphragm appropriated to it, and having passed through the pericardium, terminates in the right auricle of the heart. It has one large valve at its entrance into the auricle, named the valve of Eustachius. In its course it receives the lumbar veins; also the spermatic, renal and capsular, and phrenic veins; and finally the hepatic veins which, through the medium of the portal system, return the blood circulated through the chylopoietic viscera.

no valves in course;

branches.

Varieties

The lower vena cava presents some occasional deviations from its ordinary condition, which may be briefly noticed.

in position;

Thus, in the lower part of its course, it is sometimes placed to the left side of the aorta, and, after receiving the left renal vein, resumes its ordinary position by crossing over the great artery ["The Arteries," &c., plate 58, fig. 2]. Less frequently, the vena cava is placed altogether on the left side, and is continued upwards to the heart, without any change in its direction; the thoracic and abdominal viscera being, in such cases, transposed, as well as the great vessels [fig. 3].

in place of formation;

In another class of cases, more numerous than those just mentioned, the left common iliac vein, instead of joining the right in its usual position, is connected with it only by a small branch, and then ascends on the left side of the aorta. After receiving the left renal vein, it crosses over the aorta, and terminates by uniting with the common iliac vein of the right side. In these cases, the vena cava inferior can be said to exist only at the upper part of the abdomen, and below this point there is a vein on each side of the aorta [fig. 4].

in ending.

Lastly, the lower vena cava, instead of ending in the right auricle of the heart, has been seen to join the right azygos vein, which is then very large; so that the blood from the lower, as well as from the upper part of the body, enters the heart through the upper vena cava. In this case, the hepatic veins do not join the lower cava, but end at once in the right auricle, at the usual place of termination of the great vein [plate 5, fig. 5].

Middle sacral.

The *middle sacral* vein, fig. 157, *n*, taking its course upwards on the front of the sacrum, opens into the left common iliac vein, or into the commencement of the vena cava.

Lumbar veins like the arteries.

The *lumbar* veins, fig. 157, *o*, correspond in number with the arteries of the same name: they commence by small *dorsal* branches in the muscles of the back; and by others from the walls of the abdomen, where they communicate with the epigastric and other veins in the neighbourhood.

Branches.

Having reached the spine, they receive branches from the

spinal plexuses; and proceed forward upon the bodies of the vertebræ, behind the psoas muscle, those on the left side passing behind the aorta, to terminate in the back of the vena cava. Some of these veins are frequently found to unite into a single trunk before their termination. The lumbar veins of the same side communicate with each other by branches which cross in front of the transverse processes.

Ascending lumbar vein.

One branch is not unfrequently met with, called the *ascending lumbar* vein, which connects more or less completely the common iliac vein, the ilio-lumbar and lumbar veins, and the azygos vein (p. 388).

Spermatic;

The *spermatic* veins, fig. 157, *p*, *q*, proceeding upwards from the testicle and forming one of the constituents of the spermatic cord, enter the abdomen, and ascend on the psoas muscle behind the peritoneum. Below the abdominal ring the veins are numerous, branched, and convoluted; they form a plexus, named the *spermatic plexus* (plexus pampiniformis). These branches gradually unite, and form a single vessel, which opens on the right side into the lower vena cava, and on the left into the renal vein. The spermatic veins sometimes bifurcate before their termination, each division opening separately; in this case, the veins of the right side may be found communicating with the vena cava and the renal vein.

form a plexus; difference in ending.

Ovarian veins.

In the female the *ovarian* veins have the same general course as the ovarian arteries; they form a plexus near the ovary (ovarian or pampiniform plexus) in the broad ligament, and communicate with the uterine plexus.

Valves.

Valves exist in the spermatic veins in man (Monro); and, in exceptional cases, they have been also seen in the ovarian veins (Theile).

Renal or emulgent.

The *renal* or *emulgent* veins, fig. 157, *r*, are short, but of very considerable size. That of the left side is longer than the right, and passes in front of the aorta. They join the vena cava at nearly a right angle. The renal veins usually receive branches from the suprarenal capsules; the left has also opening into it the spermatic vein of the same side.

Branches.

Capsular.

The *capsular* or *suprarenal* veins, fig. 157, *s*, though small, are, proportionately to the organs from which they arise, of considerable size. On the right side the vein ends in the vena cava, and on the left in the renal or phrenic vein.

Phrenic.

The *phrenic* veins follow exactly the course of the arteries supplied to the diaphragm by the abdominal aorta.

PORTAL SYSTEM OF VEINS.

Portal system of veins;

In the adult, as well as in the fœtus, the veins of the liver present peculiarities which distinguish them from the rest of the venous system; for in this viscus a large venous trunk, performing as it were the function of an artery, conveys materials from which, at least in great part, the peculiar secretion of the organ is elaborated. The portal vein (vena portæ), for so is this large venous trunk called, has been named from its entering the liver at the transverse fissure—which was likened to a gateway, the small lobes placed before and behind it representing its pillars.

how formed;

The portal vein is thus formed: the veins from all the chylopoietic viscera unite into two principal trunks, the splenic and superior mesenteric; and from the junction of these two veins results the vena portæ.

general arrangement;

Having reached the liver, the portal vein again divides and ramifies in the substance of that gland, so that it may be said to have two sets of branches: one, branches of commencement in the intestines, and the other, branches of termination in the liver; both being connected by an intermediate trunk.

no valves;

Both kinds of branches are in all cases single, and destitute of valves.

join systemic veins.

The entire of these veins is named the *portal system*; it is for the most part separate from the systemic veins, but small communicating branches between the two are found at two or three spots on the alimentary tube, especially on the rectum.

Splenic vein;

The *splenic* vein, fig. 162, *b*, is a vessel of very considerable size, for it returns the blood not only from the spleen, but also from the pancreas, the duodenum, the greater part of the stomach and omentum, the descending colon, and part of the rectum. It commences by five or six branches, which issue separately from the fissure of the spleen, but soon join to form a single vessel.

course;

It is directed from left to right beneath the pancreas, in company with the splenic artery, below which it is placed. On reaching the front of the spine it joins the superior mesenteric vein, nearly at a right angle.

its branches.

It receives *gastric* branches (vasa brevia) from the left extremity of the stomach, the *left gastro-epiploic* vein, *c*, some *pancreatic* and *duodenal* branches,

and one of the three following veins, which require a more detailed notice :

The branches of the *inferior mesenteric* vein, fig. 162, *d*, correspond with the ramifications of the artery of the same name. They commence at the lower part of the rectum, Inferior mesenteric.

Fig. 162.

where they have the same looped and plexiform arrangement as the arteries just within the anus (p. 322). From this anastomotic circle companion veins ascend with the arteries, and piercing the intestine join into larger trunks. Ascending thence along the intestinal tube, the branches of the mesenteric vein unite into a single vessel near the sigmoid flexure of the colon. From this point the vein passes upwards and inwards along the lumbar region, behind the Plexiform arrangement;

peritoneum, crossing between the transverse mesocolon and the spine, though sometimes it lies farther to the left, but in either case it passes beneath and behind the pancreas, so as to reach the splenic vein in which it terminates.

ends in splenic.

Coronary vein of stomach.

The *coronary* vein of the stomach lies parallel with the artery of the same name. Its size is inconsiderable, and its direction transverse from the cardiac to the pyloric end of the stomach along the small curvature. On reaching the latter point it turns downwards, and opens into the trunk of the vena portæ.

Superior mesenteric;

The *superior mesenteric* vein, fig. 162, *e*, lies to the right side, and somewhat in front of the artery of the same name. The distribution of its branches corresponds with that of the superior mesenteric artery, and it returns the blood from the several parts supplied by that vessel, viz., from the small intestine, and from the ascending and transverse parts of the colon. The trunk formed by the union of its several branches inclines upwards and to the right side, passing in front of the duodenum and behind the pancreas, where it joins with the splenic vein.

joins splenic.

PORTAL VEIN: VENA PORTÆ.

Portal vein, "vena portæ;"

The trunk of the portal vein, fig. 162, *a*, commencing at the junction of the splenic and mesenteric veins, passes upwards and a little to the right to reach the transverse fissure of the liver, being about three inches in length. It is placed close behind and between the hepatic artery and the bile duct: and is surrounded by the filaments of the hepatic plexus of nerves, together with numerous lymphatics. All these are imbedded in loose connective tissue, and enclosed within the layers of the small omentum. Within the transverse fissure it is somewhat enlarged, and is there named *sinus of the portal vein*. Two branches open into the portal vein, viz., the superior coronary and the cystic, but the latter may be received into its branch for the right lobe of the liver.

course and connections; its sinus; veins joining.

Branches, right,

Near the right end of the transverse fissure, the vena portæ divides into two branches. That of the *right* side enters directly the substance of the corresponding lobe of the liver, and spreads out into branches, each of which is accompanied by an offset of the hepatic artery and of the hepatic duct. The *left* branch, which is smaller, but

left.

necessarily longer, passes across to gain the left end of the transverse fissure, where it enters the liver and ramifies like the preceding branch. The blood conveyed to the liver by the ramifications of the portal vein is collected again, and returned into the current of the circulation by the hepatic veins.

The *hepatic* veins, fig. 162, *t*, commence in the capillary terminations of the vena portæ. Their branches gradually unite, and become large as they pass backwards and upwards towards the back part of the liver, where the lower vena cava passes in a groove behind that organ. At this point they all end in the vena cava, passing obliquely into that vein. There are usually three sets of hepatic veins proceeding to this common point; those from the right and left lobes being oblique in their direction, those from the middle of the liver and the lobule of Spigelius having an intermediate position and course. Hepatic veins; Ending.

The hepatic veins run apart from each other, and have no companion arteries; the branches of the hepatic arteries ramifying in the liver along with the portal veins. The hepatic veins have no valves; but, owing to their oblique entrance into the vena cava, a semi-lunar fold is seen at the lower border of the orifice of each vein. by themselves; no artery; no valves.

The hepatic veins sometimes, though rarely, enter at once into the auricle of the heart—the vena cava inferior, in these cases, joining the azygos vein [plate 5, fig. 5]. Enter right auricle

In a remarkable case, observed by Rothe,* one of the hepatic veins ended, not in the lower cava, nor in the right auricle, but in the right *ventricle* of the heart, its orifice being guarded by valves. or ventricle.

VEINS OF THE HEART.

The veins of the heart (*cardiac* veins) have not the regular coronal arrangement of the arteries: they are further single veins, and are without valves except at their ending. Most of them are received into a dilated vessel at the back of the heart called the coronary sinus; and the veins that bring the blood to it are distinguished as the large, and the anterior and posterior cardiac. Are not double. Number.

The *coronary sinus* is about an inch in length, and is placed at the back of the heart in the transverse groove Coronary sinus.

* Act. Acad. Joseph. Med. Chir. Vindobonensis, t. i. p. 233, tab. 5. Vindobonæ, 1788.

Position. between the left auricle and ventricle, where it is covered by the muscular fibres of the auricle. At one end it is joined by a small vein from the right side, and opens into the right auricle beneath the Thebesian valve; at the other, it receives the large coronary vein, and a small straight vein directed obliquely along the back of the left auricle;* whilst between those points other veins enter it from the back of the heart: all the veins joining it, except the small oblique vein, are provided with more or less complete valves. This sinus is the persistent pervious end of the transformed left innominate vein of the fœtus.

Veins joining it

are valved at the ending except one.

Nature.

Great cardiac vein. The *great cardiac* vein (vena cordis magna) is a vessel of considerable size, and from the way in which it coils round the left side of the base of the heart, or rather of the ventricle, it may be named "coronary." Its chief branch runs along the groove upon the fore part of the heart, corresponding with the septum of the ventricles. Commencing at the apex of the heart, it gradually increases in size as it approaches the base of the ventricles, and then inclining backwards and to the left side in the groove between the left auricle and ventricle, ends in the coronary sinus: two valves close its aperture in the sinus. In this course it receives branches from the ventricles, especially from the left, and also from the left auricle; and when it passes by the thick margin of the left ventricle, it receives a vein of some size, which ascends to join it.

Course.

Ending.

Branches.

Posterior cardiac veins. The *posterior cardiac* veins ascend on the back of the ventricles, especially on the left, and open into the coronary sinus by four or more valved orifices. One of these, larger than the rest (middle or posterior cardiac vein), ascends along the groove between the ventricles upon the posterior surface of the heart. It commences by small branches at the apex of the heart, which communicate with those of the preceding vein, and then ascends to the base, receiving branches from the substance of both ventricles.

Small or anterior cardiac. The *small* or *anterior cardiac* veins (venæ cordis parvæ) are several small branches, which commence upon the anterior surface of the right ventricle, and pass upwards and outwards, opening separately into the right auricle,

* This is the oblique vein of Mr. Marshall, and is the remnant on the back of the left auricle of the obliterated left innominate trunk of the fœtus. See the Paper on the Development of the Veins of the Neck before cited.

after having crossed over the groove between it and the ventricle.

The *smallest cardiac* veins (venæ cordis minimæ).—Under this name are included numerous minute vessels in the substance of the heart, the orifices of which are observable on the inner surface of the right auricle. From having been noticed by an old anatomist, Thebesius, these openings are called *foramina Thebesii.* Some of these openings do not appear to be mouths of veins, but only small depressions in the wall of the auricle. Smallest cardiac.

THE ABSORBENTS.

Absorbents; consist of lacteals and lymphatics.

THE absorbent vessels consist of the *lacteals*, which convey the chyle from the alimentary canal to the thoracic duct; and of the *lymphatics*, which take up the lymph from all the other parts of the body, and return it indirectly through the thoracic duct, or directly into the venous system. Both those vessels are connected in their course with *lacteal* or *lymphatic* glands.

The general anatomy of the absorbents having been elsewhere detailed, their course and position have now to be described.

The two large trunks in which they end.

The lacteals and lymphatics are gathered into two large trunks, right and left, and join by their means the subclavian vein of the corresponding side. The vessel of the left side or the *thoracic duct*, is a large common trunk, which receives the lymphatics from both the lower limbs; from the cavity of the abdomen and its viscera, (except the upper surface of the liver,) as well as from the walls of the abdomen; from the left side of the thorax and the left lung, and from the left side of the heart; from the left upper limb; and from the corresponding side of the head and neck. The right trunk is very short, and is joined by the lymphatic vessels which arise from the right upper limb; the right side of the head and neck; from the right side of the chest and the right half of the heart and lung of the same side, and from the upper surface of the liver; this vessel may be called the *right lymphatic duct*. It is commonly named the right thoracic duct, though no part of it lies within the thorax: indeed, the duct of the left side is not exclusively thoracic, for its commencement is in the abdomen, and its termination in the neck. The thoracic duct, the right lymphatic duct, and all the principal absorbent vessels are provided with numerous valves, and have as in the veins, a varicose appearance.

Left trunk. Right trunk.

Lacteals, or chyliferous vessels;

The *lacteals* (vasa lactea, chylifera).—These vessels commence in the coats of the intestines, by a very close plexus, and extend to the thoracic duct, in which they all terminate: they are derived in far larger numbers from the small than

from the large intestine, so that they abound in the mesentery, and particularly in that part of it which corresponds with the jejunum and ileum. Two series of these absorbing vessels are found along the tube of the intestine, having different positions and directions: those nearest to the outer surface of the intestine run longitudinally in the course of the canal, lying beneath the peritoneal coat; whilst others, placed more deeply between the muscular and mucous coats, course transversely around the intestine, and are directed thence with the arteries and veins along the mesentery, enclosed within the folds of the peritoneum. It was at one time supposed that the more superficial absorbents of the intestine were lymphatics, and that only the others were lacteals; but such a distinction cannot be made between them, and they freely communicate and anastomose together. "The lacteals (says Cruikshank) absorb chyle when it is presented to them; and at other times they absorb other fluids."* The lacteals, having entered the mesentery, take the course of the blood-vessels, and pass through the numerous lymphatic glands (mesenteric glands) which exist within these peritoneal folds. The *mesenteric glands* vary in number from a hundred and thirty to a hundred and fifty; and in the healthy state are seldom larger than an almond. They are most numerous in that part of the mesentery which corresponds with the jejunum; and they seldom occur nearer to the attached border of the intestine than two inches. They are enlarged and become the seat of unhealthy deposits in mesenteric disease. Small glands are also disseminated irregularly between the folds of the peritoneum connected with the large intestine, but they are not numerous in that situation.

derived from intestines;

carry lymph as well as chyle.

Mesenteric glands very numerous.

Having passed through these glands, the lacteals gradually unite as they approach the attached border of the mesentery, two or three joining into one; and so they become diminished in number, until at length, near the root of the superior mesenteric artery, only two or three trunks remain, which end in the thoracic duct. Sometimes however six or seven of these vessels open separately into the commencement of the duct. In this way, the lacteals from the whole of the small intestine, from the cæcum, and from the ascending and transverse parts of the colon terminate: those from the descending colon and its sigmoid flexure usually

Lacteals form larger trunks.

All lacteals end in thoracic duct,

* Anatomy of the Absorbing Vessels, p. 161.

join some of the lumbar lymphatics, or turn upwards and open by a separate trunk into the lower end of the thoracic duct.

and also lymphatics of lower part of body.

To the same point, viz., the lower end of the thoracic duct, may be traced from below upwards, the lymphatic vessels from the lower limbs; so that the thoracic duct may be said to commence at the common point of junction of these lymphatics with the trunks of the lacteal vessels.

THORACIC DUCT.

Thoracic duct; its length;

origin.

The thoracic duct, fig. 163, *b*, is from eighteen to twenty inches long in the adult, and extends usually from the second lumbar vertebra to the root of the neck. Its commencement, however, is often as low as the third lumbar vertebra; and in some cases as high as the first lumbar, or even upon the last dorsal vertebra. Here there is usually a dilatation of the duct, of variable size, which is called *chyli receptaculum* (Pecquet), fig. 163, *a*. The thoracic duct lies at first to the right side of or behind the aorta, and is about three lines in diameter; it then ascends on the right side of that vessel, getting into contact with the right crus of the diaphragm, and so reaches the thorax, where it is placed at first upon the front of the dorsal vertebræ, between the aorta, 1, and the azygos vein, 8, the latter being to its right side. It ascends, gradually inclining to the left and at the same time diminishing in size, until it reaches the third dorsal vertebra, where, passing behind the arch of the aorta, it comes into contact with the œsophagus, lying between the left side of this tube and the pleura. Continuing its course, it ascends into the neck until it arrives on a level with the upper border of the seventh cervical vertebra; here it changes its direction and turns forwards, at the same time arching downwards and outwards so as to describe a curve, *d*, and then terminates on the outer side of the internal jugular vein, 7, in the angle formed by the union of that vein with the subclavian, 6. The diminution in the size of the duct as it ascends has been already noticed; at the fifth dorsal vertebra it is often only two lines in diameter, but above this point it enlarges again. It is generally waving and tortuous in its course, and is constricted at intervals or varicose in its appearance. The thoracic duct is not always a single trunk throughout its whole extent: it frequently divides opposite the seventh

Chyli receptaculum.

Position of duct in abdomen,

in thorax,

in neck;

ends in great veins of neck.

Is sometimes divided;

or eighth dorsal vertebra into two trunks, which soon join again; sometimes it separates into three divisions, which afterwards unite, and enclose between them spaces or islets. Cruikshank in one case found the duct double in its entire length; "in another triple, or nearly so." In the neck, the thoracic duct often divides into two or three branches, which in some instances terminate separately in the great veins, but in other cases unite first into a common trunk.

double or triple.

May end by more than one opening.

Fig. 163.*

The thoracic duct has numerous double valves at intervals throughout its whole course, which are placed opposite to the nodulated parts of the vessel. They are more numerous in the upper part of the duct. At the termination of the duct in the veins there are two valves, so placed as to allow the contents of the duct freely to pass into the veins, but which would effectually prevent the regurgitation of either chyle or blood back into the duct.

Valves.

THE RIGHT LYMPHATIC DUCT.

The right lymphatic duct, fig. 163, c, is a short vessel, about a line or line and a half in diameter, and about three quarters of an inch in length, which receives the lymph from the absorbents of the right upper limb, and the right side of the head and chest as before said (p. 412). It enters obliquely into the receding

Right lymphatic duct; course;

and termination.

* The aorta is marked 1, the left subclavian artery 2, the left carotid 3, the upper cava 4, the left innominate vein 5, the left subclavian

angle formed by the union of the right subclavian and internal jugular veins, where its orifice is guarded by two valves.

The course of those lymphatic vessels which pour their contents into the thoracic duct will be now described, beginning with those of the lower limb.

LYMPHATICS OF THE LOWER LIMB.

Lymphatics of lower limb.

The lymphatics of the lower limb are arranged in a superficial and a deep series.

Superficial;

accompany veins:

one set with internal;

The *superficial lymphatics*, placed in the superficial fascia of the limb, are gathered into two sets, of which one accompanies the long saphenous, whilst the other follows the course of the short saphenous vein. The vessels composing the first or *internal* set commence on the dorsum and inner side of the foot, and, passing partly in front and in part behind the inner ankle, ascend along the inner side of the knee and front of the thigh, and terminate in the superficial inguinal glands. In their course these vessels are joined by numerous branches proceeding from the integuments of the leg and the thigh. The lymphatics which constitute the second or *external* division of the subcutaneous series, are much less numerous than those just described. Commencing upon the outer margin of the foot, they pass behind the outer malleolus, and ascend along the back part of the leg; here they perforate the fascia, and proceed between the heads of the gastrocnemius muscle to terminate in the lymphatic glands of the popliteal space. This course corresponds with that of the short saphenous vein, which these lymphatics accompany.

another with external saphenous.

Deep, with deep blood-vessels.

The *deep-seated lymphatics* of the lower limb, associated in their whole course with the deep blood vessels, require but a brief description. In the leg they consist of three divisions, namely, anterior tibial, posterior tibial, and peroneal. Neither these nor the superficial absorbents pass through any lymphatic gland in the leg, unless it be those lymphatics which accompany the anterior tibial artery, for a small gland is sometimes found on the front of the inter-

vein 6, the left internal jugular vein 7, the azygos vein 8, the psoas muscles 9, 9. *a*, *b*, *d*, is the thoracic duct; *a*, the receptaculum chyli; *b*, the trunk of the vessel; *d*, its termination in the neck; *c* is the right lymphatic duct.

osseous ligament, above the middle of the leg. The several sets of deep lymphatics in the leg ascend with the blood-vessels, and enter the lymphatic glands situate in the popliteal space. These, the *popliteal lymphatic glands*, are usually very small, and four or five in number: they surround the popliteal vessels, and are imbedded in a quantity of loose fat. The popliteal glands receive from below the deep lymphatics of the leg, and those which accompany the short saphenous vein; and from them proceed efferent vessels, which ascend with the femoral artery to the groin. Popliteal glands.

The lymphatic glands of the groin, *inguinal glands*, like the lymphatic vessels of that part, are, from their relative position, divisible into a superficial and a deep set; the former being placed immediately under the integument, the latter under the fascia lata. The *superficial glands* are larger than the others; their number varies much, but it may be stated to average about eight or ten; they are disposed irregularly about Poupart's ligament and the saphenous opening of the fascia, a few sometimes extend for two or three inches downwards along the saphenous vein. Besides the lymphatics of the lower limb, the inguinal glands are joined by the superficial absorbent vessels from the perinæum, and the external generative organs, as will be presently noticed; and by those from the lower part of the abdominal wall and the integuments covering the outer side of the pelvis. The efferent vessels of the superficial inguinal glands perforate the fascia, come into connection with those situate deeply, pass into the abdomen by the side of the blood-vessels, and terminate in a chain of lymphatics lying along the external iliac artery, which end in the lumbar glands. The *deep-seated glands* are placed beneath the others, around the femoral artery and vein. Inguinal glands; superficial set. Lymphatics of external organs of generation; of outside the pelvis. Their ducts. Deep set of glands.

Other deep lymphatics, derived from the muscles on the pelvis, and many proceeding from the adductor muscles of the thigh, in company with the gluteal, sciatic, and obturator arteries, enter the cavity of the pelvis with those vessels, and pass through a series of glands situate in the neighbourhood of the internal and common iliac arteries. Deep lymphatics with vessels.

LYMPHATICS OF THE ABDOMEN AND PELVIS.

Superficial lymphatics of the abdomen and pelvis.—The lymphatic vessels of the *walls* of the abdomen and pelvis consist of several series which pursue different directions, but Lymphatics of abdomen;

all are associated with the blood-vessels of different parts. A superficial series, derived from the integument of the lower part of the abdomen (from the umbilicus downwards), descends towards the superficial inguinal glands; whilst a deep-seated series in the same situation is also directed downwards, and ends in the glands situate on the external iliac artery: these two sets follow respectively the superficial and deep epigastric blood-vessels.

from fore part, superficial and deep.

From lateral and back parts.

Other lymphatics, proceeding from the sides and back part of the walls of the abdomen, perforate the fibres of the muscles; a small number of them then wind round the iliac crest, passing in their course through one or two small glands, and proceed along Poupart's ligament with the circumflex iliac artery, to terminate in the glands upon the external iliac artery; whilst the greater number are directed backwards with the ilio-lumbar and lumbar arteries, and, being joined by the lymphatics from the muscles and integument of the back, pass behind the psoas muscle to the vertebral column, where they enter the glands surrounding the aorta and lower vena cava.

Join glands.

Superficial of pelvis.

The *superficial lymphatics* of the *pelvis*, as already described, are directed for the most part towards the inguinal glands.

Superficial of penis;

The *superficial lymphatics of the penis* usually form three vessels, two being placed at the sides, and the other on the dorsum of the organ. Commencing in the prepuce and underneath the mucous lining of the urethra, they pass backwards, unite on the dorsum penis, and, again subdividing, send branches on each side to the inguinal glands. The *deep-seated* lymphatics of the penis pass under the pubic arch, and end in the glands on the internal iliac artery.—The lymphatics of the external generative organs in the female present a similar disposition to that here described in the male.

Deep of the penis;

of scrotum.

The *lymphatics of the scrotum*, with those from the integument of the perinæum, may be associated together; for all, guided, as it were, by the superficial pudic vessels, enter the inguinal lymphatic glands.

Deep lymphatics

Deep lymphatics of the pelvis and abdomen—lymphatics of the viscera.—The course of these deep lymphatic vessels is indicated, as in other parts, by that of the principal blood-vessels.

of bladder;

The *lymphatics of the bladder*, taking rise from the entire surface of that organ, enter the glands placed about the

internal iliac artery: with these are associated the lymphatics of the prostate gland and vesiculæ seminales.

The *lymphatics of the rectum* are frequently of considerable size: immediately after leaving the intestine, some of them pass through small glands which lie contiguous to it; finally, they enter the lymphatic glands situate in the hollow of the sacrum, or those higher up in the loins. of rectum

In the unimpregnated state of the *uterus*, its lymphatics are small, but during the period of gestation they are considerably enlarged. Issuing from the entire substance of the organ, the greater number descend, together with those of the vagina, and pass backwards to enter the glands upon the internal iliac artery; thus pursuing the course of the principal uterine blood-vessels. Others, proceeding from the upper end of the uterus, run outwards in the folds of peritoneum which constitute the broad ligaments, and join the lymphatics derived from the ovaries and Fallopian tubes. The conjoined vessels then ascend with the ovarian arteries, near the origin of which they terminate in the lymphatic vessels and glands placed on the aorta and vena cava. of ovaries;

The *lymphatics of the testicle* commence in the substance of the gland, and upon the surface of the tunica vaginalis. Collected into several large trunks, they ascend with the other constituents of the spermatic cord, pass through the inguinal canal, and accompany the spermatic vessels in the abdomen to enter the lumbar lymphatic glands. of testicle;

The *lymphatics of the kidney.*—Those placed upon the surface of the organ are comparatively small; they unite at the hilus of the kidney with other lymphatics from the substance of the gland, and then pass inwards to the lumbar lymphatic glands. The lymphatics of the *suprarenal capsules* unite with those of the kidney. The lymphatic vessels of the *ureter* are numerous; they communicate with those of the kidney and bladder, and for the most part terminate with the former. of kidney; suprarenal bodies; of ureter:

The *lymphatics of the stomach* are placed, some beneath the peritoneal coat, and others between the muscular and mucous coats. Following the direction of the blood-vessels, they become arranged into three sets. One set accompanies the coronary vessels, and receiving, as it runs from left to right, branches from both surfaces of the organ, turns backwards near the pylorus, to join some of the larger trunks. Another series of lymphatics, from the left end of the stomach, follow the vasa brevia, and unite with the of stomach;

lymphatics of the spleen; whilst the third set, guided by the right gastro-epiploic vessels, incline from left to right along the great curvature of the stomach, from which they pass backwards, and at the root of the mesentery terminate in one of the principal *lacteal* vessels.

their termination.

Of spleen;

The *lymphatics of the spleen* are placed, some immediately under its peritoneal covering, others in the substance of the organ. Both sets converge to the inner side of the spleen, come in contact with the blood-vessels, and, accompanying these, pass through a series of small glands, and terminate in the lymphatics of the digestive organs.

termination.

Pancreas.

Lymphatics emerge from the *pancreas* at different points, and join those derived from the spleen.

Liver.

The *lymphatics of the liver* are divisible into three principal sets, according as they are placed upon its upper or its under surface, or are spread through its substance with the blood-vessels.

On upper surface; four sets.

The lymphatic vessels scattered upon the *upper* surface of the liver incline towards particular points, and so become distinguishable into groups, of which four are ordinarily enumerated. Thus, from the middle of this surface five or six branches run towards the falciform ligament, on which, directed forwards, they unite to form a large trunk, that passes upwards between the fibres of the diaphragm, behind the ensiform cartilage. Having reached the interpleural space behind the sternum, they ascend through a chain of lymphatic glands found upon the internal mammary blood-vessels, and are thus conducted to the root of the neck, generally at the right side, where they terminate in the right lymphatic duct. The second group consists of vessels which incline outwards towards the right lateral ligament, opposite to which they unite into one or two larger lymphatics; these pierce the diaphragm, and run forwards upon its upper surface to join the preceding set of vessels behind the sternum. In some cases however instead of passing into the thorax, they turn inwards on reaching the back part of the liver, and, running upon the crus of the diaphragm, open into the thoracic duct close to its commencement. Another set of lymphatics is found upon the left lobe of the liver; the vessels of which it is composed, after reaching the left lateral ligament pierce the diaphragm, and, turning forwards, end in the anterior glands in the mediastinum. Finally, along the fore part of the liver some vessels will be

First; Second; Third; Fourth.

observed to turn downwards and join those placed upon the under surface.

The under surface of the liver is covered by an open network of lymphatic vessels. On the right lobe they are directed over and under the gall-bladder to the transverse fissure, where some join the deep lymphatics; whilst others, passing through some scattered lymphatic glands, are guided by the hepatic artery to the right side of the aorta, where they terminate in the thoracic duct. Branches also proceed to the concave border of the stomach, between the folds of the small omentum, to join with the coronary lymphatics of that organ. On under surface.

The *deep lymphatics of the liver* accompany the branches of the portal vein in the substance of the organ, and pass out of the gland by the transverse fissure. After communicating with the superficial lymphatics, and also with those of the stomach, they pass backwards, and join, at the side of the cœliac artery, with one of the *lacteal* trunks previously to its termination in the thoracic duct. In substance of organ; their termination.

The absorbent vessels of the *intestines*, named the *lacteals*, have been already described (page 412). So, too, have the mesenteric glands connected with those vessels (p. 413). It now remains to consider the other lymphatic glands situate in the pelvic and abdominal cavities. Lacteals.

The lymphatic glands of the pelvis and abdomen.—The lymphatics of the lower half of the body may be followed, within the abdomen, to a continuous series of glands, placed in front of the sacrum and vertebral column. Though connected by absorbent vessels passing from one to another, these glands are more numerous at particular points, and are accordingly arranged into several groups. In the pelvis, some of the glands are placed behind the rectum in the hollow of the sacrum, and are hence named *sacral lymphatic glands.* Others, again, surrounding the internal iliac artery, are denominated the *internal iliac glands.* They receive the lymphatics corresponding to the branches of the internal iliac artery, and communicate upwards with the lumbar glands. Lymphatic glands of pelvis and belly. Sacral, internal iliac, and

The *lumbar lymphatic glands* are very large and numerous; they are placed in front of the lumbar vertebræ, around the aorta and vena cava. To these may be traced the lymphatics of the lower limb, as well as those which accompany several of the branches of the abdominal aorta. lumbar glands.

The efferent absorbent vessels which proceed from these End of effe-

rent vessels from glands. glands progressively increase in size, while their number diminishes, and at length they unite into a few trunks, which, with those of the lacteals, form the origin of the thoracic duct.

THE LYMPHATICS OF THE THORAX.

Lymphatics of thorax; The lymphatics of the thorax are divisible into two sets, viz., those derived from the walls, and those from the viscera of that cavity. The former are arranged in two distinct planes, one lying between the skin and the muscles, the other being deeply seated.

superficial; in front. The *superficial* lymphatics at the front of the chest run upon the great pectoral muscle, and for the most part are directed towards the axilla, where they enter the lymphatic glands. Those upon the back lie on the trapezius and latissimus dorsi, and inclining from various directions, also converge to the axilla, and end in the same series of glands as the lymphatics of the upper limb.

Deep in front; The *deep* absorbents at the fore part of the chest correspond, in their general distribution, with the internal mammary artery: commencing in the muscles of the abdomen, they ascend between the fibres of the diaphragm at its attachment to the ensiform cartilage, and then continue behind the costal cartilages to the top of the thorax. In their course they receive branches from the anterior part of the intercostal spaces, and ultimately terminate on the left side in the thoracic duct, and on the opposite side in the right lymphatic duct. at sides and back of chest; The deep lymphatics at the sides and back part of the chest follow the distribution of the aortic intercostal arteries: they receive some absorbent vessels which come forwards, through the intertransverse spaces, from the parts seated in the vertebral grooves, and other vessels which run along the intercostal spaces. their termination. All these incline inwards to the spine, and terminate in the thoracic duct.

Lymphatics of lungs; superficial, The *lymphatics of the lungs*, like those of other organs, form two sets, one being superficial, the other deep-seated. Those at the surface run beneath the pleura, where they form a network by their anastomoses. Their number is considerable, but they are sometimes difficult of demonstration. "I have been able," says Cruikshank,* "at one time

* Anatomy of the Absorbents, p. 194.

to show the whole external surface of the lungs covered with absorbents I had injected; at another time I have not been able to find one."

One of the easiest methods of finding them is to inflate the lungs of a still-born child from the trachea; the air passes from the cells into the absorbents, and enables us to see those on the surface: if a puncture be made into one of them with a lancet, the air will partially escape, and then the injecting pipe, containing a column of quicksilver, can be introduced.*

Most of these superficial lymphatics converge to the root of the lung, and terminate in the bronchial glands.

The deep lymphatics of the lungs run with the blood-vessels along the bronchi; they communicate freely with those upon the surface, and at the root of the lung open into the bronchial glands. From these, two or three trunks issue, which ascend along the trachea to the root of the neck, and terminate on the left side in the thoracic duct, and on the right in the lymphatic duct of that side. and deep; their termination.

The *lymphatics of the heart* follow the coronary vessels from the apex of the organ towards the base. Those of the right side meet near the origin of the aorta, so as to form a trunk of some size; the vessel runs upwards over the aortic arch, and passes backwards between the innominate and left carotid arteries to reach the trachea, along which it ascends to the root of the neck to terminate in the right lymphatic duct. The left lymphatics of the heart ascend to the base of the organ; where they communicate with the preceding set, and having united into a single vessel, proceed along the pulmonary artery towards its bifurcation. At this point the vessel passes through some lymphatic glands behind the arch of the aorta, and ascends by the trachea to terminate in the thoracic duct. Lymphatics of heart; differ on right and left sides, in their termination.

The *lymphatics of the œsophagus* form along that tube a plexus of vessels, passing upwards upon it, and traversing the glands which lie in their course: after having communicated by anastomoses with the lymphatics of the lungs, at and near the roots of those organs, they terminate in the thoracic duct. Of œsophagus; termination.

The lymphatics of the *thymus gland* and those of the *thyroid* body may be now described with the absorbents of the thorax. Of thymus gland.

"On the spinal surface of the thymus gland," Sir Astley

* Loc. cit.

Cooper observes,* "numerous absorbent glands are found; and if these be injected, many absorbents are discovered. But upon the posterior surface of the cornua and cervical portion, two large vessels proceed on each cornu, and the side of the trachea.—They pass nearly straight upon the spinal surface of the cornua, converging a little as they proceed towards the sternum, and terminate in the jugular veins by one or more orifices on each side."

Of thyroid body.

The lymphatics of the thyroid body.—From each lateral lobe of this organ some absorbing vessels arise, which converge and unite to form one short trunk, that opens at the right side into the right lymphatic duct, at the left into the thoracic duct. They may be demonstrated by inserting the injecting pipe into the substance of the gland, when the mercury will force its way into the lymphatics by its weight.

Lymphatic glands in chest;

The lymphatic glands of the thorax.—In describing the vessels, mention has already been made of the glands through which they pass in various situations. Thus, along the course of the internal mammary blood-vessels there are placed six or seven small glands, through which the lymphatics behind the sternum pass; they may be named

mediastinal; the *anterior mediastinal* glands. Between the intercostal muscles and along the heads of the ribs on the side of the

intercostal; spine is a set of glands, named *intercostal*, which receive the lymphatics from the thoracic parietes and pleura. Three

cardiac; or four lymphatic glands, *cardiac*, lie behind the aortic arch, and one before it; and another cluster, varying from fifteen to twenty in number, are found along the œsopha-

œsophageal; gus—*œsophageal glands.* At the root of the lungs there are ten or twelve glands of much larger size than those just

bronchial, are largest. mentioned: these are the *bronchial glands.* The largest of them occupy the interval between the right and left bronchi at their divergence, whilst others of smaller size rest upon these tubes for a short distance within the lungs. In early infancy their colour is pale red; towards puberty, we find them verging to grey, and studded with dark spots; at a more advanced age they are frequently very dark. In chronic diseases of the lungs they sometimes become enlarged and indurated, so as to press on the air-tubes, and cause much irritation. They are frequently the seat of tuberculous deposits.

* Anatomy of the Thymus Gland, p. 14.

LYMPHATICS OF THE UPPER LIMB.

In the upper limb, as in the lower, the lymphatics are arranged into a superficial and a deep set—the former accompanying the subcutaneous veins, the latter following the course of the deep blood-vessels. Lymphatics of upper limb.

The *superficial lymphatics* form two divisions, which correspond with the subcutaneous veins on the outer and inner borders of the limb. One set accompany the branches of the ulnar cutaneous vein from the inner border of the hand, along the front and inner side of the fore arm as high as the bend of the elbow. In this course they receive numerous collateral branches, and join at the point just indicated with some of those from the outer side of the fore arm. Continuing their course upwards along the arm, a few of them passing through a lymphatic gland situate in front of the inner condyle of the humerus, these absorbent vessels terminate either in glands, or in the axilla where they unite with the deep lymphatics. Those which constitute the *second* set, are less numerous than the preceding, and are placed along the outer border of the fore arm. They commence beneath the integuments on the outer and back part of the hand, and follow the course of the radial cutaneous veins to the bend of the elbow; here the greater number of them join the vessels last described, whilst a few ascend with the cephalic vein, on the outer side of the arm, and passing with that vessel between the deltoid and great pectoral muscles, end beneath the clavicle in one or more lymphatic glands connected with those at the lower part of the neck. Superficial, with veins. Ulnar set. Lymphatic gland before inner condyle. Radial set of lymphatics.

The *deep* lymphatics of the upper limb correspond with the deep blood-vessels. In the fore arm they consist, therefore, of three sets, associated with the radial, ulnar, and interosseous arteries and veins. In their progress upwards, they have a communication near the wrist with the superficial lymphatics; and some of them enter the glands which lie by the side of the brachial artery near the bend of the elbow. All terminate in the glands of the axilla. Deep set; with deep vessels. Brachial glands.

The *axillary glands* are generally ten or twelve in number; in this respect however, as well as in their size, they vary considerably in different individuals; they are placed along the axillary vessels, imbedded in a quantity of loose fatty tissue, and a few are situate at some distance Axillary glands: number and size.

below the vessels, against the serratus magnus muscle. They receive the lymphatics of the arm already described, as well as those proceeding from the integuments of the back, from the fore part of the thorax, and from the mammary gland. Hence they are liable to be influenced by diseases affecting any of those parts.

Lymphatics joining them.

From the glands in the axilla, efferent lymphatic vessels, fewer in number, but larger in size than the afferent vessels, proceed along the course of the subclavian artery, in some parts twining round it. From the top of the thorax they ascend into the neck, close to the subclavian vein, and terminate,—those of the left side in the thoracic duct, those of the right side in the right lymphatic duct. Sometimes they unite into a single trunk, which opens separately into the subclavian vein near its termination.

Termination of lymphatics of upper limb.

LYMPHATICS OF THE HEAD AND NECK.

The lymphatics of the head include those of the cranium and the face.

Lymphatics of head;

Commencing beneath the scalp, the *lymphatics of the cranium* join together so as to diminish in number whilst they increase in size, and are at length collected into an anterior and a posterior set, which follow respectively the course of the temporal and the occipital arteries. The *temporal* set descend in front of the ear, some of the vessels passing through one or two glands usually found near the zygoma, whilst others enter those situate on the parotid gland; all of them terminate in the lymphatic glands of the neck. The *occipital* set of the cranial lymphatics, accompanying the occipital artery, descend to the glands situate behind the ear, viz., over and near the mastoid process of the temporal bone, and thence join the superficial lymphatics of the neck.

of cranium, temporal series, and glands; occipital series, and glands.

Within the cranial cavity, lymphatic vessels have been demonstrated in the pia mater and in the arachnoid membrane. None have been injected in the dura mater, nor have they been shown in the substance of the brain. The trunks of those derived from the pia mater pass out of the skull with the veins.

Lymphatics of the pia mater and arachnoid.

The *superficial lymphatics of the face,* more numerous than those of the cranium, descend obliquely in the course of the facial vein, and join the submaxillary glands, six to

Of the face; superficial,

ten in number, which are placed beneath the base of the lower maxillary bone ; a few of them in their descent pass through some glands situate over the buccinator muscle. The *deep* lymphatics of the *face* are derived from the temporal fossa and the cavities of the nose, mouth, and orbit, and proceed in the course of the internal maxillary vein : having reached the angle of the jaw, they enter the glands in that spot. deep.

The *lymphatic glands* found on different parts of the *head* and *face* are few and very small : those on the *neck*, on the contrary, are comparatively large and very numerous. Lymphatic glands of head and face.

The *cervical glands* are almost all placed on the sides of the neck, and are divisible into a superficial and a deep series. Of the former, some lie beneath the base of the inferior maxillary bone ; the remainder, arranged along the course of the external jugular vein, exist in greatest number in the angular space behind the lower end of the sterno-mastoid muscle, where that vein enters the subclavian vein : at this point the cervical glands approach, and are connected with the glands of the axilla. The *deep cervical* glands are placed along the carotid artery and internal jugular vein, extending downwards on the sheath of those vessels as far as the thorax. Cervical glands ; superficial set ; deep set.

The lymphatic vessels of the cranium and face (already described), together with those of the pharynx, tongue, larynx, and other parts of the neck, pass into the cervical glands. From these efferent vessels issue, which progressively diminish in number during their descent, and unite into a single trunk at the bottom of the neck. On the left side this single vessel enters the thoracic duct, close to its termination, and on the opposite side ends in the right lymphatic duct : sometimes, however, it terminates separately at the junction of the subclavian and internal jugular veins, or in one of those vessels immediately before they unite. Termination of lymphatics of head and neck.

NERVOUS SYSTEM.

CEREBRO-SPINAL AXIS.

Nervous system; central and peripheral.

THE *nervous system* consists of two parts—a central part, which includes the brain and spinal cord, and is named the cerebro-spinal axis, and a peripheral part, which comprises all the nerves in the body. The anatomy of the nerves, which again are subdivided into a cerebro-spinal and a sympathetic system, will be subsequently treated of, whilst the present section will be devoted to a description of the central portion of the nervous system.

Cerebro-spinal centre is symmetrical,

The *cerebro-spinal axis* is contained partly within the cavity of the cranium, and partly within the vertebral canal; it is symmetrical in its form and structure throughout, consisting of a right and a left half, which correspond in every particular, and are joined together along the middle line by fibres of nervous substance, which pass across the longitudinal fissures existing between them. These connecting fibres form the commissures of the brain and spinal cord.

and enclosed within skull and vertebral canal;

Enclosed with the skull and the vertebral canal, the cerebro-spinal axis is protected by the bony walls of those two cavities; but it is also surrounded by three membranes, which afford it additional protection and support, and are subservient to its nutrition. These envelopes, which will be described hereafter, are, a dense fibrous membrane named the dura mater, a serous membrane called the arachnoid, and a highly vascular membrane named the pia mater.

consists of spinal cord and encephalon, which is again divided.

The cerebro-spinal axis is divided by anatomists into the encephalon (ἐν, κεφαλὴ, the head), the enlarged upper part contained within the cranium, and the *spinal cord*, contained within the vertebral canal. The encephalon is again divided into the *cerebrum* or *brain proper*; the *cerebellum*, little brain, or *after-brain*; the *tuber annulare*, or pons Varolii, and the *medulla oblongata*. It should be remarked, that the term *brain*, in a general sense, is commonly applied to the entire encephalon, but that it also has a limited application to the cerebrum only.

WEIGHT OF THE ENCEPHALON.

The chief sources of information on this subject are the tables published by Dr. Sims,* Dr. Clendinning,† Tiedemann,‡ and Dr. John Reid.§ The following table is deduced from their observations. The weights given by Tiedemann have been converted into ounces avoirdupois, the weight employed by the three British observers. All instances of fractional parts of ounces are classed with the next highest integral number, so that the term 50 oz., for example, includes all cases of brains weighing more than 49 oz., but not exceeding 50. From the tables of Dr. Sims and Dr. Clendinning those cases have been rejected in which cerebral disease is said to have existed.

TABLE I.

MALES, aged 21 years and upwards.

Weight in oz. avoirdupois.	Number of brains at each weight observed by: Clendinning.	Sims.	Tiedemann.	Reid.	Total number at each weight.	Classification into three groups, to show the *prevailing weight.*
34	—	—	—	1	1	62 cases. from 34 oz. to 45 oz. Difference 11.
37	—	2	—	—	2	
38	1	—	—	—	1	
39	—	3	—	1	4	
40	—	2	—	1	3	
41	—	3	—	2	5	
42	2	4	2	—	8	
43	—	6	2	3	11	
44	1	6	2	3	12	
45	6	8	—	1	15	
46	2	10	—	8	20	170 cases. from 46 oz. to 53 oz. Difference 7.
47	2	6	—	10	18	
48	4	8	2	11	25	
49	3	2	2	12	19	
50	4	4	5	13	26	
51	3	3	2	19	27	
52	—	5	4	6	15	
53	4	2	4	10	20	
54	3	2	1	5	11	46 cases. from 54 oz. to 65 oz. Difference 11.
55	—	—	2	4	6	
56	—	—	1	6	7	
57	—	—	—	2	2	
58	—	1	4	2	7	
59	—	1	2	3	6	
60	—	—	—	1	1	
61	—	—	2	1	3	
62	—	—	1	—	1	
63	—	—	—	1	1	
65	—	—	1	—	1	
Tot.	35 +	78 +	39 +	126 =	278	

FEMALES, aged 21 years and upwards.

Weight in oz. avoirdupois.	Number of brains at each weight observed by: Clendinning.	Sims.	Tiedemann.	Reid.	Total number at each weight.	Classification into three groups, to show the *prevailing weight.*
31	—	—	—	1	1	32 cases. from 31 oz. to 40 oz. Difference 9.
32	—	1	—	—	1	
35	—	2	—	—	2	
36	—	4	—	—	4	
37	—	3	1	2	6	
38	2	—	—	—	2	
39	—	3	1	2	6	
40	3	3	—	4	10	
41	2	8	—	2	12	125 cases. from 41 oz. to 47 oz. Difference 6.
42	3	6	1	3	13	
43	6	6	—	7	19	
44	5	4	—	13	22	
45	4	9	—	7	20	
46	2	9	2	12	25	
47	2	5	—	7	14	
48	—	2	2	2	6	34 cases. from 48 oz. to 56 oz. Difference 8.
49	—	1	2	7	10	
50	—	2	1	4	7	
51	—	—	2	4	6	
52	1	—	—	—	1	
53	—	1	—	—	1	
54	—	2	—	—	2	
56	—	1	—	—	1	
Tot.	30 +	72 +	12 +	77 =	191.	

* Sims; Medico-Chirurg. Trans., vol. xix., pp. 353—7.
† Clendinning; Medico-Chirurg. Trans., vol. xxi., pp. 59—68.
‡ Tiedemann; Das Hirn des Negers, Heidelberg, 1837, pp. 6, 7.
§ Reid; London and Edinburgh Monthly Journal of Medical Science, April, 1843, p. 298, &c.

In male; in female;

According to this table, the maximum weight of the adult male brain, in a series of 278 cases, was 65 oz., and the minimum weight 34 oz. In a series of 191 cases, the maximum weight in the adult female was 56 oz., and the minimum 31 oz.; the difference between the extreme weights in the male subject being no less than 31 oz., and in the female 25 oz. The weight of the adult male brain appears, therefore, to be subject to a wider range of variety than that of the female. By grouping the cases together in the manner indicated by brackets, it is found that in a very large proportion, the weight of the male brain ranges between 46 oz. and 53 oz., and that of the female brain between 41 oz. and 47 oz. The *prevailing* weights of the adult male and female brain may therefore be said to range between those terms; and by taking the mean, an *average* weight is deduced of 49½ oz. for the male, and of 44 oz. for the female brain,—results which correspond closely with the statements generally received.

average weight in each sex.

Male brain is heavier at all periods.

Although many female brains exceed in weight particular male brains, the general fact is sufficiently shown, that the adult male encephalon is heavier than that of the female,—the average difference being from 5 to 6 oz. This general superiority in absolute weight of the male over the female brain, is shown by Table II. to exist at every period of life. In new-born infants the brain was found by Tiedemann to weigh 14¼ oz. to 15¾ oz. in the male, and 10 oz. to 13¼ oz. in the female.*

Brain reaches its maximum weight

Anatomists have differed considerably in their statements as to the period at which the brain attains its full size, and also as to the effect of old age in diminishing the weight of this organ. Sœmmerring concluded that the brain reached its full size as early as the third year; the Wenzels and Sir W. Hamilton fixed the period about the seventh, and Tiedemann between the seventh and eighth. Gall and Spurzheim were of opinion that the brain continued to grow until the fortieth year. The tables of Dr. Sims show a gradual increase in the weight of the brain up to the twentieth year, and a further irregular increase, until the maximum is reached between forty and fifty years, after which there is a decrease. From the following Table (II.), founded on the observations of Sims, Tiedemann, and Reid, it appears that in general the weight of the brain increases rapidly up to the seventh year, then more slowly to between sixteen and twenty, and again more slowly to between thirty-one and forty, at which time it reaches its maximum point. Beyond that period, there appears a slow, but progressive diminution in weight of about 1 oz. during each subsequent decennial period; thus confirming the opinion, that the brain diminishes in advanced life.† It will also be seen from the table that the general results are the same in both sexes.

about 31 to 40 years, then diminishes.

* This fact is not without interest in practical midwifery, for it has been shown that by far the larger number of difficult labours occur in the birth of male children. Professor Simpson—London and Edinburgh Monthly Journal of Medical Science, 1845.

† Huschke, who has recently examined the brains of 359 men and 245 women, finds that the maximum weight is attained at the thirtieth year in both sexes. The weight of the brain in males diminishes from that period, but in females it remains stationary until the climacteric age is attained, when the diminution begins. In both sexes

TABLE II.—WEIGHT OF THE ENCEPHALON.

Weight in oz.	Birth.	1 Year	1 to 4.		4 to 7.		7 to 10.		10 to 15.		16—20.		21—30.		31—40.		41—50.		51—60.		61—70.		71—80.		81 to 90.		Weight in oz.
10	1	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
12	1 1'	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
14	1 1'	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
16	1'	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16
18	--	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18
20	--	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
22	--	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	22
24	--	1 1'	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24
26	--	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26
28	--	1'	—	1'	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	28
30	--	--	1	1'	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30
32	--	1 1'	—	2'	—	1'	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1'	—	1'	32
31	--	--	—	3'	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	34
36	--	--	3	2'	—	2'	—	—	—	—	—	—	—	2'	—	2'	—	1'	—	—	—	1'	—	1'	—	—	36
38	--	--	—	6'	—	2'	—	1'	—	—	—	—	—	1'	—	1'	—	2'	3	2'	1	1'	—	1'	—	—	38
40	--	1	1	2'	1	2'	—	—	—	1'	—	1'	1	6'	—	1'	—	3'	3	4'	3	1'	—	1'	—	—	40
42	--	--	2	5'	3	2'	2	1'	—	1'	—	2'	2	5'	3	3'	1	8'	2	4'	3	2'	1	4'	3	1'	42
44	--	--	—	—	2	2'	2	1'	1	4'	—	4'	3	12'	8	12'	5	6'	5	7'	4	5'	4	2'	—	—	44
46	--	--	1	1'	1	—	—	4'	3	2'	—	5'	2	6'	5	11'	8	7'	10	6'	8	7'	3	3'	—	—	46
48	--	--	—	1'	1	—	1	—	—	—	1	3'	7	7'	9	2'	13	8'	5	4'	9	—	4	—	1	—	48
50	--	--	—	—	1	—	1	—	3	—	—	2'	7	5'	12	5'	16	3'	6	1'	4	—	1	1'	2	—	50
52	--	--	—	—	—	—	2	—	1	—	1	—	8	—	7	2'	15	—	7	—	2	—	—	—	—	—	52
54	--	--	—	—	1	—	—	—	—	—	3	1'	1	—	8	1'	7	1'	3	—	—	—	2	—	—	—	54
56	--	--	—	—	—	—	1	—	1	—	2	—	2	—	3	—	1	—	5	—	—	1'	—	—	—	—	56
58	--	--	—	—	—	—	—	—	—	—	—	—	1	—	5	—	1	—	2	—	1	—	1	—	—	—	58
60	--	--	—	—	—	—	—	—	1	—	—	—	—	—	3	—	2	—	—	—	2	—	—	—	—	—	60
62	--	--	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	62
64	--	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	64
66	--	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	66
	3-3'	4-3	9-22'		10-11'		9-7'		10-8'		7-18'		34 — 44'		58 — 40'		71 — 39'		51 — 28'		37 — 16'		16 — 14'		6 — 2'		

The preceding table contains the weight of 580 brains of both sexes, 325 male, and 255 female, arranged according to age. The horizontal lines mark the weight in oz. (avoirdupois), each line or interspace indicating a difference of two ounces. The vertical columns show the ages from birth up to 90 years, the width of each column being proprortionate to the period which it includes. The figures in these columns show the number of brains at each weight.

The curved lines, drawn as nearly as may be through the average weight in each column, present to the eye the different variations in weight through the whole period.

The accented figures and the dark line refer to the female brains. The dotted line drawn between two of the columns of male brains is intended to show that the extreme deviation of the thin line at that place, is regarded as an irregularity, depending probably on the small number of male brains collected at that age.

Size of brain in proportion to intellect.

All other circumstances being alike, the size of the brain appears to bear a general relation to the mental power of the individual,—although instances occur in which this rule is not applicable. The brain of Cuvier weighed upwards of 64 oz.,* and that of the late Dr. Abercombie about 63 oz. avoirdupois.† On the other hand, the brain in idiots is remarkably small. In three idiots, whose ages were sixteen, forty, and fifty years, Tiedemann found the weight of their respective brains to be 19¾ oz., 25¾ oz., and 22½ oz.; and Dr. Sims records the case of a female idiot twelve years old, whose brain weighed 27 oz.

Human brain as compared with animals.

The weight of the human brain being taken at about 3 lbs. (48 oz.), it is found to be absolutely heavier than the brain of all the lower

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there is a slight increase of weight in extreme old age. The following Table is from Huschke (Canst. Jahres. 1855) :—

Age.	Males (270 cases.)	Females (215 cases.)
10 to 19	1411 grammes.	1219 grammes.
20 to 29	1419 ,,	1260 ,,
30 to 39	1424 ,,	1272 ,,
40 to 49	1406 ,,	1272 ,,
50 to 59	1398 ,,	1239 ,,
60 to 69	1291 ,,	1219 ,,
70 to 79	1254 ,,	1129 ,,
80 to 90	1303 ,,	1186 ,,

Vòn Bibra's researches afford a different result, and one agreeing with that of Tiedemann, viz. that there is a diminution in advanced age.

* Emille Rousseau—Maladie et autopsie de M. G. Cuvier. Lancette Française, Mai 26, 1832. The precise weight given by M. Rousseau is 3 livres, 11 ounces, 4½ gros (old French weight). This being reduced to kilogrammes and thence converted into oz. avoirdupois, gives 64 oz. and nearly one-third.

† Cormack's Journal, December, 1844. Dupuytren's brain is stated by Tiedemann (op. cit. p. 9) to have weighed 58 oz. Apothecary's wt. = 63⅓ oz. avoirdupois. But in the Report of the Autopsy published in the Lancette Française, Feb. 1835, the weight is given as 2 livres 14 ounces (old French wt.) = only to 50 oz. avoirdupois.

animals except the elephant and whale. In the elephant, the brain, according to Perrault, Moulins, and Sir A. Cooper, weighs between 8 and 10 lbs.; whilst that of the whale was found by Rudolphi, in a specimen 75 feet long, to weigh upwards of 5 lbs.*

The *relative weight of the encephalon to the body* is liable to great variation; nevertheless, the facts to be gathered from the tables of Clendinning, Tiedemann, and Reid, furnish this interesting general result:—In a series of 81 males, the average proportion between the weight of the brain and that of the body, at the ages of twenty years and upwards, was found to be as 1 to 36·5; and in a series of 82 females, to be as 1 to 36·46. In these cases, the deaths were the result of more or less prolonged disease; but in 6 previously healthy males, who died suddenly from disease or accident, the average proportion was 1 to 40·8. Weight of brain to weight of body, in health;

The proportionate weight of the brain to that of the body is greater at birth than at any other period of life, being, according to Tiedemann, about 1 to 5·85 in the male, and about 1 to 6·5 in the female. From the tables already referred to, it further appears that the proportion diminishes gradually up to the tenth year, being then about 1 to 14. From the tenth to the twentieth year, the relative increase of the body is most striking, the ratio of the two being at the end of that period about 1 to 30. After the twentieth year, the general average of 1 to 36·5 prevails, with a further trifling decrease in advanced life. at different periods of life;

Viewed in relation to the weight of his body, the brain of man may be stated generally to be heavier than the brains of the lower animals; but there are some exceptions to the rule, as in the case of certain species of small birds, in the smaller apes, in monkeys, and in some small rodent animals. as compared with animals.

In some of the examples in the following table,† the brain is heavier, and in others lighter relatively to the body than it is in man.

Blue-headed Tit	1 to 12	Porpoise . .	1 to 93
Canary . .	1 to 14	Rabbit . .	1 to 140
Goldfinch . .	1 to 24	Cat . .	1 to 156
Linnet . .	1 to 24	Dog . . .	1 to 305
Monkey (small)	1 to 22	Horse . .	1 to 400
Field-Mouse .	1 to 31	Elephant . .	1 to 500
Gibbon . .	1 to 48	Sheep . .	1 to 350
Rat . . .	1 to 76	Ox . . .	1 to 860‡

M. Leuret § has found from extensive observation, that the propor- Weight of

* In Tiedemann, op. cit. p. 15.

† Selected from Cuvier's Leçons, &c. 2d Edition, par F. G. Cuvier & Laurillard. 1845. Paris.

‡ We are indebted to Professor Owen for the following information concerning the relative weight of the brain and body in the Chimpanzee (Simia Troglodytes).

Weight of brain, in a half-grown male $9\frac{3}{4}$ oz.
Weight of body, in a nearly adult female, 61 lbs = 976 oz.
Proportion between the two weights 1 to 100.

§ Anat. Comp. du Syst. Nerv. &c. Paris, 1839. Tom. i. p. 423.

brain to body in the four classes of vertebrata.

tionate weight of the brain to the body, in the four classes of vertebrate animals, may be represented by the following numbers :

In Fishes, as	1 to 5668	In Birds,	1 to 212
Reptiles,	1 to 1321	Mammalia,	1 to 186

WEIGHTS OF THE SEVERAL PARTS OF THE ENCEPHALON.

As the result of observations made in reference to this subject, on the brains of 53 males and 34 females, between the ages of twenty-five and fifty-five, Dr. J. Reid has given the following table :—

Weight of cerebrum, cerebellum, pons, and medulla oblongata.

	Males.		Females.		Difference.	
	oz.	drs.	oz.	drs.	oz.	drs.
Average weight of cerebrum	43	15¾	38	12	5	3¾
,, cerebellum	5	4	4	12¼	0	7¾
,, pons and medulla oblongata		15¾	1	0¼	0	½
,, entire encephalon	50	3½	44	8½	5	11

From this it appears that the proportionate weight of the cerebellum to that of the cerebrum, is, in the male, as 1 to 8⁴⁄₇, and in the female as 1 to 8¼. Huschke, from a special examination of the brains of 22 females, and 38 males, arrives at the same conclusion with regard to the weight of the cerebellum, pons, and medulla oblongata. This portion of the nervous system attains its maximum weight from the twenty-fifth to the fortieth year; but the increase in weight after the fourteenth year is shown to be relatively greater in the female than the male. The cerebellum apart from the pons and medulla is heavier in the male, the lobes of the cerebellum are also heavier in the male. In the male the vermiform process increases gradually from the twentieth to the fiftieth year; in the female it remains stationary during that period, and after the fiftieth year diminishes rapidly.

Ratio between cerebrum and cerebellum.

In the new-born infant the ratio is strikingly different to what it is in the adult, being, according to Chaussier, from 1 to 13 to 1 to 26; by Cruveilhier it was found to be 1 to 20.*

In most mammalia, the cerebellum is found to be heavier in proportion to the cerebrum, than it is in the human subject; in other words, the cerebrum is larger in proportion to the cerebellum in man.

Ratio of cerebrum to cerebral nerves.

Sœmmerring † pointed out the fact that the brain is larger in proportion to the nerves connected with it in man than in the lower animals. With the view of showing the size of the brain in proportion to the rest of the nervous system in different cases, a comparison has been made of the width of the cerebrum with that of the medulla oblongata. From this it appears, that the proportionate diameter of the brain to that of the medulla oblongata is greater in man than in

Width of cerebrum to width of medulla oblongata.

* Huschke who weighed the cerebellum, medulla oblongata, and pons together, found their weight in the newborn infant, as compared with that of the brain, in the proportion of 1 to 15, and 1 to 13. In the adult, the proportions were 1 to 7, and 1 to 6.

† De basi encephali, Gœttingae. 1778.

any animal, except the dolphin, in which creature it must be remembered that the cerebral lobes exhibit a disproportionate lateral development. The width of the cerebrum in man, as compared with that of the medulla oblongata at its base or broadest part, is about 7 to 1. in man;

In the ourang it is	6 to 1	in animals.
In certain monkeys	5 and 4 to 1	
In the dog	11 to 6	
In the cat	11 to 4	
In the rabbit	8 to 3	
In the ox	13 to 5	
In the horse	21 to 8	
In the falcon	34 to 13	
In the sparrow	18 to 7	
In the dolphin	13 to 1*	

WEIGHT OF THE SPINAL CORD.

Weight of spinal cord

Divested of its membranes and nerves, the spinal cord in the human subject weighs from 1 oz. to $1\frac{3}{4}$ oz., and therefore its proportion to the encephalon is about 1 to 33. Meckel gives it as 1 to 40.

as compared with brain,

The disproportion between the brain and the spinal cord becomes less and less in descending the scale of the vertebrata, until at length, in the cold-blooded animals, the spinal cord becomes heavier than the brain. Thus, in the mouse, the weight of the brain, in proportion to that of the spinal cord, is as 4 to 1 ; in the pigeon, as $3\frac{1}{3}$ to 1 ; in the newt, only as $\frac{5}{9}$ to 1 ; and in the lamprey, as $\frac{1}{75}$ to 1.

or with body.

In comparison with the size of the body, the spinal cord in man may be stated in general terms to be much smaller than it is in animals. In regard to the cold-blooded animals, to birds, and to small mammalia, this has been actually demonstrated, but not in reference to the larger mammalia.

THE SPINAL CORD.

Spinal cord lies in the vertebral canal, down to first lumbar vertebra;

The *spinal cord*, or *spinal marrow* (medulla spinalis), is that part of the cerebro-spinal axis which is situated within the vertebral canal. It extends from the margin of the foramen magnum of the occipital bone, to about the lower part of the body of the first lumbar vertebra. It forms the continuation of the medulla oblongata above, and ends below in a slender filament, which is prolonged to the termination of the sacral canal.

does not fill the canal;

The spinal cord does not occupy, either by its length or thickness, the entire space within that canal. On the contrary, invested closely by a proper membrane (the pia

* Cuvier's Leçons : ut suprà.

mater), the cord is enclosed within a sheath, both longer and larger than itself, which is formed by the dura mater, and which is itself separated from the walls of the canal by numerous vascular plexuses, and much loose areolar tissue. The interval between the investing membrane and the sheath of the cord, is lined by a serous membrane (the arachnoid), and is filled by a fluid called the cerebro-spinal fluid. Within this space the cord is suspended or supported by proper ligaments, which serve to fix it at different points to its sheath. The anterior and posterior roots of the several pairs of spinal nerves pass across the space from the surface of the cord, towards the corresponding intervertebral foramina. Since the cord terminates at the upper part of the lumbar region, it occupies only the upper two thirds of the vertebral canal, and the elongated roots of the lumbar and sacral nerves, which descend nearly vertically from the cord to reach the lumbar intervertebral and the sacral foramina, form a lash of nervous cords named the *cauda equina*, which occupies the remaining and lower third of the vertebral canal.

has a space around it, and a sheath;

a space below it, containing

cauda equina.

Position of lower end varies;

Although the cord usually ends near the lower border of the body of the first lumbar vertebra, it sometimes terminates a little above or below that point, as opposite to the last dorsal or to the second lumbar vertebra. The position of the lower end of the cord also varies according to the state of curvature of the vertebral column, in the flexion forwards of which, as in the stooping posture, the end of the cord is slightly raised.—In the fœtus, at an early period, the length of the cord corresponds with that of the vertebral canal; but after the third month, the canal and the roots of the lumbar and sacral nerves begin to grow more rapidly in proportion, so that at birth the lower end of the cord reaches only to the third lumbar vertebra.

reaches bottom of vertebral canal in fœtus.

Its length,

form, and

enlargements,

cervical,

lumbar;

The length of the spinal cord is from fifteen to eighteen inches; and it varies in diameter in different situations. Its general form is cylindrical, but it is somewhat flattened before and behind. It is not of uniform size or shape throughout, but presents two enlargements—an upper, or cervical, and a lower, or lumbar. The cervical enlargement is of greater size and extent than the lower. It reaches from the third cervical to the first dorsal vertebra; its greatest diameter is from side to side. The lower or lumbar enlargement is situated about opposite the last dorsal vertebra; its greatest diameter is from before backwards,

and by Foville * it is said to be chiefly due to an increase in bulk of the anterior region of the cord.—Below this enlargement, the cord tapers into a conical point. Sometimes it forms one or two bulbs or swellings towards its lower end. The cervical and lumbar enlargements have an evident relation to the size of the nerves which supply the upper and lower limbs, and which are connected with those regions of the cord,—in accordance with the general fact observed in the animal kingdom, that near the origin of large nerves, the nervous substance is accumulated in larger proportion. At the commencement of its development in the embryo, the spinal cord is destitute of these enlargements, which, in their first appearance and subsequent progress, correspond with the growth of the limbs.

Is pointed at lower end: sometimes swellings there.

The long free and slender filament in which the cord terminates, descends in the middle line amongst the nerves composing the cauda equina, and, becoming blended with the lower end of the sheath opposite to the first or second sacral vertebra, passes on to be fixed to the lower end of the sacral canal, or to the base of the coccyx. It is named the *central ligament* of the spinal cord; it is of a fibrous structure externally, and contains internally nervous substance, traceable at any rate for some distance from its upper end. It appears to be a prolongation of the pia mater or innermost membrane, which, being attached at its lower end to the dura mater and vertebral canal, keeps pace with the latter in its growth, whilst the cord relatively shortens. It consists principally of white fibrous tissue with a few fine elastic filaments intermixed; and it must assist in supporting the cord, and in maintaining its position during the movements of the trunk. A small vein has been sometimes seen upon it.

Termination of cord.

Central ligament.

When removed from the vertebral canal, and divested of its membranes, the spinal cord is seen to be marked by longitudinal *fissures*. Of these, two run along the middle line, one in front and the other behind, and are named the *anterior* and *posterior median fissures*, fig. 164, *a* and *p*. By means of these, which penetrate only a certain distance into its substance, the cord is divided into two lateral and symmetrical halves, which, however, are connected in their whole length by a cross portion of nervous substance called the *commissure*.

Median fissures of cord.

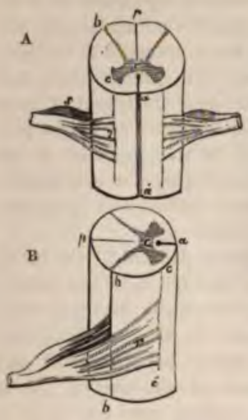
Divide it into halves.

* Traité compl. de l'Anat., &c., du Syst. Nerv. Cerebro-Spinal. Paris, 1844. Part I. p. 138.

Anterior fissure.

The *anterior median fissure*, *a a′*, is more distinct than the posterior, and penetrates about one-third of the thickness of the cord, but its depth increases towards the lower end. It contains a fold or lamelliform process of the pia mater, and also many blood-vessels, which are thus conducted to the centre of the cord. At the bottom of this fissure is seen the connecting portion of white substance named the *anterior white commissure.*

Fig. 164.*



Posterior fissure.

The *posterior median fissure*, *p p*, is less marked in the greater part of its extent than the anterior, but becomes more evident towards the upper part of the cord. Numerous blood-vessels, accompanied by slender filamentous processes derived from the inner membrane, pass into this fissure. Lastly, the bottom of the fissure is separated from the central grey matter of the cord only by a very thin layer of white substance, which has been named the posterior white commissure ; but some maintain that the fissure actually reaches the grey matter ; others state that the posterior fissure as such does not exist at all in man, except at the lumbar enlargement, and in the upper cervical region. It is, however, not supposed that there is no division between the posterior columns ; they are separated from each other by numerous vessels.

Lateral fissures opposite roots of nerves.

Besides these two *median* fissures, two *lateral* furrows or fissures have been described on each side of the cord, corresponding with the lines of attachment of the spinal nerves. The anterior and posterior roots of these nerves, as will be hereafter specially described, are attached to the cord in four

* Plans in outline, showing the front A, and the side B, of the spinal cord with the fissures upon it ; also sections of the grey and white matter, and the roots of the spinal nerves. *a*, *a*, Anterior. *p p*, Posterior fissure. *b*, Posterior, and *c*, Anterior horn of grey matter. *e*, Grey commissure. *a e c*, Anterior white column. *c e b*, Lateral columns. *a e b*, antero-lateral column. *b e p*, Posterior columns. *r*, Anterior, and *s*, Posterior roots of a spinal nerve.

rows, of which two are seen in front, fig. 164, *r*, at a little distance on either side of the anterior median fissure, and two behind, *s*, near the posterior median fissure. Now, along the line of attachment of the posterior roots, there is in each half of the cord a fissure leading down to the grey matter, which there comes to the surface. This is the *posterior lateral fissure*, *b*, by which the corresponding half of the cord is divided into an anterior and a posterior column. Posterior lateral fissure is evident.

By some anatomists, an *anterior lateral fissure* has been described as existing along the line of attachment of the anterior roots, B, *c c'*; but, in reality, there is no fissure to be seen on the surface at this part, although the white substance of the cord is divided by a prolongation of the grey matter, A, *c*, from within, which, however, does not reach the surface. Thus, each lateral half of the cord is divided by the posterior lateral fissure into a *posterior*, *p c b*, and an *antero-lateral* column, *a c b*; and although we cannot trace an anterior lateral fissure, this antero-lateral portion of the cord may, for the convenience of description, be considered as subdivided into an *anterior* and a *lateral column* by the internal grey matter. Anterior lateral is not so. Columns of cord.

On the posterior surface of the cord (throughout *its whole length*, according to Foville, but much more evidently in the upper part,) there are two slightly-marked longitudinal furrows situated one on each side, close to the posterior median fissure, and marking off, at least in the cervical region, a slender tract, named the *posterior median* column. Between the roots of the spinal nerves, on each side, the cord is convex, and sometimes has a longitudinal mark upon it, corresponding with the line of attachment of the ligamentum denticulatum. Posterior median column.

Foville * states that in a new-born child, there is a narrow accessory bundle of white matter, running along the surface of the lateral column, separated from it by a streak of greyish substance. According to the same authority, this narrow tract enlarges above, and may be traced upwards along the side of the medulla oblongata into the cerebellum.

Structure of the spinal cord.—The spinal cord consists of white and grey nervous substance. The white matter is situated externally, whilst the grey matter is disposed in the interior, in a peculiar manner, to be now described. On a transverse section, figs. 164, 165, it presents two crescent- Structure of cord. Central grey matter

* Op. cit. p. 285.

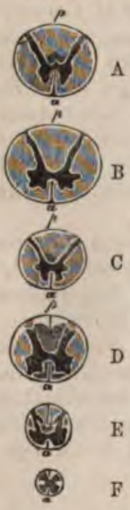
forms two crescents, joined back to back.

shaped masses of similar form, placed one in each lateral half of the cord with their convexities towards one another, and joined across the middle by a transverse portion of grey matter. Each of these grey crescents has an anterior and a posterior cornu or horn. Of these, the posterior is long and narrow, and reaches the surface at the posterior lateral fissure. The anterior horn is shorter and thicker than the posterior ; it extends towards the line of attachment of the anterior roots of the nerves, but it does not reach the surface of the cord. The transverse median portion of *grey* matter which connects the two crescents is named the *grey commissure* of the cord, *c*. In front of it there is a tolerably thick layer of white substance, separating it from the bottom of the anterior median fissure, *a* ; this is named the *anterior white commissure*. In like manner there is another white layer behind the grey matter, named the *posterior white commissure*, but this is very thin and indistinct, so that its existence has been denied by anatomists of good authority.

Grey commissure.

White commissure; anterior and posterior.

Fig. 165.*



At its junction with the white substance, the grey matter presents a somewhat jagged or indented outline, especially in the anterior horn of each crescent.

Substantia gelatinosa.

At the tip of the posterior horn, which is somewhat enlarged, the grey matter has a peculiar semi-transparent aspect, whence it was named by Rolando, *substantia cinerea gelatinosa*.

White substance is more abundant than grey.

The white substance forms by far the larger portion (it is said nearly seven-eighths) of the cord. Owing to the peculiar arrangement of the grey matter, the white substance in each semi-cylindrical half of the cord is divided into two principal columns, which have been already noticed in describing its surface ; viz., a posterior and an antero-lateral column. The posterior column, fig. 164, *p c b*, is situated between the posterior

Its columns posterior,

* Shows sections of the cord at various heights, exhibiting the internal grey matter, and in some cases the anterior and posterior median fissures (Arnold). A. Section between 2nd and 3rd cervical nerve. B. Below the 6th cervical. C. Below the 10th dorsal. D. Below the 3rd lumbar. E. Below 2nd sacral. F. Below 5th sacral nerve. *a a a a*, Anterior surface. *p p*, Posterior surface of cord.

median fissure and the posterior lateral fissure with the corresponding cornu of grey matter: it is wedge-shaped, the point of the wedge being directed forwards towards the centre. The remaining portion of white substance constitutes the antero-lateral column *a e b*, which is bounded behind by the posterior cornu of grey matter *b*, and on the inner side by the anterior median fissure *a*. It is partially subdivided by the anterior grey cornu *c*, into a lateral, *c e b*, and an anterior column, *a e c*, the latter being joined to the corresponding column of the other half of the cord by means of the white commissure. antero-lateral, subdivided into anterior and lateral.

According to this view there are three principal columns in each half of the cord, viz., an anterior, a lateral, and a posterior column, in addition to the slender tract adjoining the posterior median fissure already described, which is generally reckoned as part of the posterior column. Posterior median column.

The white substance of the cord has been described as if disposed in thin wedge-shaped and longitudinal laminæ, placed in a radiating manner, with their inner edges in contact with the grey matter. Such a regular arrangement of lamellæ does not exist, but the white substance is collected into compressed longitudinal bundles, between which small blood-vessels run transversely into the substance of the cord, supported for a certain distance by delicate processes of membrane derived from the pia mater. White substance not laminated, but in bundles.

There is an appearance of transverse decussating bundles in the anterior commissure, but this is to be attributed to the frequent interruption of the white substance by foramina for the transmission of small blood-vessels. Transverse fibres.

The arrangement of the white and grey substances, though agreeing generally with the description just given, is somewhat modified at different parts of the cord, as may be seen in sections made at different heights. Thus, the horns of the grey crescents are long and slender in the cervical portion, fig. 165, A, B, short and more slender in the dorsal, C, and short but much wider in the lumbar region, D, E; where, according to Mr. Clarke, they are continuous with each other, forming one blunted mass, so that the grey matter appears, in a series of sections, to be, relatively to the white, more abundant in the lumbar region of the cord, E, less so in the cervical region, A, B, and least so in the dorsal, C, D. The quantity of white matter is greatest in the neck. Towards the lower end of the cord F, the double crescentic appearance gradually ceases, and the grey matter is collected Arrangement of grey and white matter varies at different heights.

into a central mass, which is indented at the sides. At its extreme point, according to Remak and Valentin, it consists of grey matter only.

Canal in spinal cord in animals,

In fishes, reptiles, and birds, during the whole period of life, a canal exists along the centre of the spinal cord. It is found also in the fœtus of mammiferous animals, and even in the young of that class. In the human fœtus, as shown by Tiedemann, there also exists, until after the sixth month, a central canal formed by the closing in of an open groove previously existing. In the adult human subject, the upper portion of this canal can be traced from the point of the calamus scriptorius in the floor of the fourth ventricle, for about half an inch or more down the centre of the cord, where it closes. In its closed and shrunken condition, however, it may be traced throughout the whole length of the cord in the adult, and appears on a section as a small round spot in the centre of the grey matter. Its lining epithelium, described by Mr. L. Clarke as columnar, may be plainly seen within its circular area.

and in human fœtus;

but is closed afterwards,

except at upper end;

The minute or microscopic structure of the cord, including the arrangement of the roots of the nerves within it, will be considered afterwards.

THE ENCEPHALON.

Encephalon and its parts.

We have now to describe the four principal parts into which the encephalon is divided, viz., the cerebrum, the cerebellum, the pons Varolii, and the medulla oblongata. But their general position within the skull, and their relations to each other, require first to be understood.

Cerebrum is largest part;

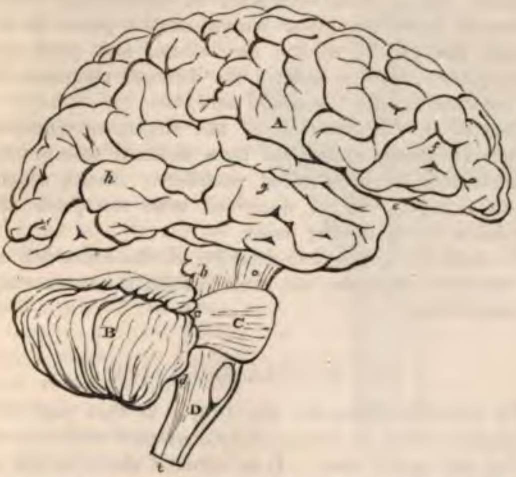
The *cerebrum*, fig. 166, A, which constitutes the highest and by far the largest part of the human encephalon,* occupies the upper and larger portion of the cranial cavity. A line drawn from a little above the orbit to the auditory meatus, met by another from the occipital protuberance to the same point, will nearly indicate on the living head, the inferior limit of the cerebrum. In front, it rests in the anterior fossa of the base of the skull; behind this, in the middle fossa; and still further back, it overlies the cerebellum, above which it projects posteriorly, resting on the tentorium, a horizontal partition formed by the dura mater between the cerebrum and the cerebellum. In all this extent, as well as above and at the sides, the cerebrum is free and unattached,

its position in skull;

* See pp. 430, 434, for the weight of these parts.

but from the middle of its under surface there proceeds a comparatively narrow and constricted portion, part of which, *a*, forming the crura cerebri or peduncles of the brain, its peduncles.

Fig. 166.*



descends into the pons Varolii below, and, through it, is continued into the medulla oblongata; whilst another part, *b*, passes down to join the cerebellum.

The *cerebellum*, B, is placed beneath the hinder part of the cerebrum, by which it is completely overlapped, the tentorium separating one from the other. It is lodged in the inferior occipital fossæ, and is attached to the rest of the encephalon, at its fore part, by means of connecting portions named *crura:* of these, two, *b*, ascend to the cerebrum, two, *d*, pass downwards to the medulla oblongata, D, and two, *c*, horizontally forwards, so as to embrace the peduncles of the brain, in front of which they unite to form the transverse eminence of the *pons Varolii*. Cerebellum.

* A plan in outline, showing, in a lateral view, the parts of the encephalon separated somewhat from each other. A. Cerebrum. *f*, *g*, *h*. Its anterior, middle, and posterior lobes. *e*. Fissure of Sylvius. B. Cerebellum. C. Pons Varolii. D. Medulla oblongata. *a*. Peduncles of cerebrum. *b*. Superior; *c*. Middle; and *d*, Inferior peduncles of cerebellum. The parts marked *a*, *b*, *c*, C, form the isthmus encephali.

Pons Varolii.

The *pons*, C, itself rests upon the upper part of the basilar process, in front; it receives the cerebral peduncles above, and the middle crura of the cerebellum behind and at the sides; whilst the medulla oblongata is connected with it below.

Medulla oblongata.

Lastly, the *medulla oblongata*, D, descending obliquely backwards from the lower border of the pons, is placed beneath the middle of the cerebellum, and rests on the basilar groove, until it reaches the foramen magnum, where it is continuous with the spinal cord, *t*.

Cavities or ventricles of brain.

Situated in the interior of the brain, surrounded by nervous substance and lined by a delicate membrane, are certain serous cavities, called *ventricles*. These, which are five in number, will be described with the parts of the encephalon in which they occur.

We shall now proceed to describe, in the following order, the medulla oblongata, the pons Varolii, the cerebrum, and the cerebellum.

THE MEDULLA OBLONGATA.

Medulla oblongata:

The *medulla oblongata*, fig. 169, *v*, is that part of the encephalon which is immediately connected with the upper end of the spinal cord. It is bounded above by the lower border of the pons Varolii, whilst it is continuous below with the spinal cord, opposite the foramen magnum. By some, its inferior limit is, with reason, fixed rather lower down, on a level with the upper border of the atlas, at a point which corresponds with the lower extremity of the anterior pyramids, to be presently described.*

its limits; sometimes differently defined;

its position;

The medulla oblongata inclines obliquely downwards and backwards, fig. 170, towards the foramen magnum. Its anterior surface rests in the basilar groove, whilst its posterior surface is received into the fossa, named the vallecula, between the hemispheres of the cerebellum, and there forms the floor of the fourth ventricle. To its sides, several large nerves are attached, fig. 169.

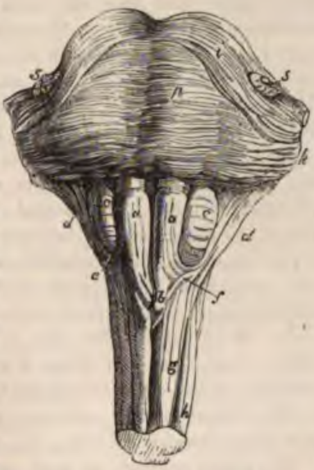
form;

It is of a pyramidal form, fig. 167, having its broad extremity turned upwards, from which it tapers to its point

* The term medulla oblongata, as employed by Willis, by Vieussens, and by those who directly followed them, included the crura cerebri and pons Varolii, as well as that part between the pons and the foramen magnum, to which, by Haller first, and by most subsequent writers, this term has been restricted.

of connection with the spinal cord : it is expanded laterally at its upper part. Its length from the pons to the lower extremity of the pyramids is about an inch and a quarter; its greatest breadth is about three quarters of an inch; and its thickness from before backwards, about half an inch. dimensions.

Fig. 167.*



The pia mater having been removed, the medulla oblongata is seen to be marked longitudinally by an anterior and a posterior fissure, which are continuous with those of the spinal cord. Of these, the *anterior*, between *a a*, terminates immediately below the pons, *p*, in a cul-de-sac, called the foramen cœcum, by Vicq-d'Azyr. It is penetrated by a fold of the pia mater. Its fissures; anterior;

The *posterior* fissure, fig. 168, is deep but narrow; it is continued upwards into the floor of the fourth ventricle, *v v'*, where it becomes a superficial furrow, and is gradually lost. posterior.

By means of these two fissures, the medulla oblongata is partially divided like the cord, into two lateral and symmetrical halves. But here the resemblance ceases; for on each side of the median line an entirely new arrangement prevails; the lateral fissures disappear, and the surface of each half of the medulla presents four eminences or columns, which, on commencing at the anterior fissure and proceeding backwards each way to the posterior fissure, are met with in the following order: the anterior pyramids, the olivary bodies, the restiform bodies, and the posterior pyramids. Columns of cord are here differently arranged.

* An anterior view of the medulla oblongata. *a a*. Anterior pyramids. *b*. Their decussation across the middle line. *c c*. The olivary bodies. *d d*. Restiform bodies. *e*. Arciform fibres. *f*. Fibres shown by Solly to pass from anterior column of cord to cerebellum. *g*. Anterior column. *h*. Lateral column. *p*. Pons Varolii. *i*. Its upper fibres. 5, 5. Roots of fifth nerves.

Anterior pyramids; The *anterior pyramids*, fig. 167, *a*, *a*, so called from their position and shape, are two bundles of white substance, placed on either side of the anterior fissure, which are shape; narrower at the lower end, and become broader and more prominent as they ascend towards the pons Varolii. At pass through pons Varolii to brain; their upper end they are constricted, and thus enter the substance of the pons, *p*, through which their fibres may be traced into the peduncles of the brain. The outer border of each pyramid is marked off from the olivary body, *c*, by a slight depression. By their inner borders the pyramids form the sides of anterior fissure. form the sides of the anterior fissure. Over a space, commencing about eight or ten lines below the pons and extending to the lower end of the medulla, a portion of each pyramid, arranged in several bundles, passes downwards Opposite pyramids decussate, across the fissure to the opposite side. This *decussation of the pyramids*, *b*, as it is called, is partial, for it affects only the innermost fibres, and consists of from three to five intersecting bundles from either side. When traced from by fibres coming principally or entirely from behind. below, it is found that the whole or a great part of these fibres come forwards from the deep portion of the lateral columns of the cord (as appears first to have been pointed out by Rosenthal *), and advance to the surface, between the diverging anterior columns, *g g*, which are thus thrown aside.

Only inner fibres decussate. The outer portion of each pyramid does not decussate ;† it consists of fibres, derived from the anterior column of the cord : these all ascend and are joined by the decussating portion from the opposite side. Together they form a prismatic bundle or column of white fibres, which extends deeply into the substance of the medulla, and is triangular in a cross section (see fig. 177, *b*).

No grey matter. The anterior pyramids contain no grey matter.

Olivary bodies; The *olivary bodies* (olivæ, seu corpora olivaria), fig. 167, *c c*, are two prominent oval masses placed to the outer side of the pyramids, and sunk to a considerable depth in the substance of the medulla oblongata, appearing on its surface project on front of medulla; like two smooth oval eminences. They are placed parallel to the outer border of the pyramids, and therefore incline outwards towards their upper end. They do not reach the

* Ein Beytrag zur Encephalotomie, 1815.

† The decussation of the anterior pyramids was noticed about the beginning of the last century by Mistichelli. Though doubted by Morgagni, Haller, Vicq-d'Azyr, and many others, it is a well-established fact, and has been supposed to afford some explanation of the cross effect of certain injuries and diseases of the brain.

pons Varolii above, being separated from it by a deep depression; nor do they extend so far in a downward direction as the pyramids, than which they are considerably shorter.

The olivary bodies consist externally of white substance, of which the fibres chiefly run longitudinally; and internally of a grey nucleus, named *corpus dentatum* or *ciliare*.

white externally; grey nucleus within, named corpus dentatum,

On making a section, whether horizontal or vertical, this grey matter, which is of a light yellowish colour, appears in form of a zig-zag line, circumscribing a whitish substance within, and interrupted towards the centre of the medulla (see fig. 177, 178, *c*). The grey matter or nucleus of the olivary body therefore is arranged in the form of a pouch or capsule, which is open at its upper and inner part and has its sides corrugated or plicated, so as to give the indented appearance to a section, from which its name has been derived. This pouch is, moreover, surrounded with white matter externally, and through its open part white fibres pass into or issue from its interior, and connect it with other parts of the brain. The external fibres of the anterior columns of the cord, which are here thrown outwards, as already mentioned, are continued upwards, on the surface of the medulla oblongata, and then pass partly on the outside and partly beneath the olivary bodies—being joined in their further progress by the fibres issuing from the olivary nucleus. To these fibres on each side, the term olivary fasciculus has been applied.

why so named.

Grey matter interrupted on inner side.

White fibres form olivary fasciculus.

The *restiform bodies* (corpora restiformia). Behind and to the outer side of the olivary body, are two lateral rounded eminences or columns, called from their rope-like appearance, the *restiform bodies*, fig. 167, *d d*. These are directly continuous with the posterior, and with part of the antero-lateral columns of the cord; they diverge slightly as they ascend, and thus occasion the great width of the medulla at its upper part. Each of them passes into the corresponding hemisphere of the cerebellum, and constitutes its inferior peduncle.

Restiform bodies,

at sides and back of medulla,

form inferior peduncles of cerebellum;

The restiform bodies are well seen, on a posterior view, fig. 168, *d d*. First, they are in contact with the small tracts of the medulla, named the posterior pyramids, *p*; but higher up they become free and prominent, and assist in forming the lateral boundaries of the fourth ventricle.

By far the larger portion of the external white substance of the restiform body consists of longitudinal fibres, which

White fibres of restiform body,

from each column of cord.

include all those belonging to the posterior column of the cord, except the fasciculi graciles, *p*, some derived from the lateral column, and also a small band from the anterior column. This last-named band, fig. 167, *f*, runs obliquely below the olivary body and connects the anterior column with the cerebellum, as was first shown by Mr. Solly.†

Fibres shown by Solly.

Fig. 168.*

The part of the posterior column of the cord which belongs to the restiform body of the medulla, is named the fasciculus cuneatus by the German anatomists: below *d*, on the right side.

Grey matter.

There is a considerable portion of grey matter in the interior of the restiform body. This is for the most part much diffused: but one large mass, fig. 177, *d*, continuous below with the substantia gelatinosa, or grey matter forming the posterior cornu of the cord, is thrown out towards the side of the medulla, and generally appearing as a longitudinal streak at the surface, forms the grey tubercle of Rolando (tuberculo cinereo).

Grey tubercle of Rolando.

Posterior pyramids or fasciculi graciles, are very slender;

The *posterior pyramids* (fasciculi graciles), *p p*, fig. 168, of the medulla oblongata, are the smallest of the four columns into which it is divided. They are situated in contact with each other, one on either side of the posterior median fissure. They consist entirely of white fibres, and are continuous with the posterior slender tracts already described as existing on the posterior median aspect of the

* Posterior view of the medulla oblongata, and back of the pons Varolii. The peduncles of the cerebellum are cut short. *d d*. Restiform bodies, (fasciculi cuneati,) passing up to become inferior peduncles of cerebellum. *p p*. Posterior pyramids. *v v*. Posterior fissure, or calamus scriptorius, extending along the floor of the fourth ventricle. *a a*. Nates. *b b*. Testes. *f f*. Superior peduncles of cerebellum. *c*. Eminence connected with hypoglossal nerve. *e*. With glossopharyngeal nerve. *i*. With vagus nerve. *v′*. With spinal accessory nerve. 7, 7. Roots of auditory nerves.

† Phil. Trans. for May, 1836.

cord. On reaching the lower part of the medulla, the posterior pyramids become somewhat swelled out, and then, diverging from one another, they become closely applied to the restiform bodies, and have been considered to be blended with them, and therefore to contribute to form the inferior peduncles of the cerebellum. But, according to Burdach and Arnold, these small columns ascend to the cerebrum. their connections.

The triangular portion of the back of the medulla, which is bounded on each side by the diverging posterior pyramids below, and by the restiform bodies higher up, constitutes the floor of the fourth ventricle, that part of it, namely, which is called the *calamus scriptorius*, *v'*. Upon it, the grey matter of the centre of the medulla oblongata, is, as it were, opened out to view. It is marked by a median furrow *v v'*, and at its lower end is a tubular recess, or cul-de-sac, passing down the centre of the medulla for a few lines. This, which has been sometimes named the *ventricle of Arantius*, is the upper portion of the central canal of the spinal cord already spoken of. Floor of fourth ventricle. Calamus scriptorius. Ventricle of Arantius.

In the upper part of the floor of the ventricle are two longitudinal eminences, one on each side of the middle furrow. These are formed by two bundles of white fibres, mixed with much grey matter, the *fasciculi teretes* of some authors, *les faisceaux innominés* of Cruveilhier. They seem to be derived from part of the lateral columns of the cord; Cruveilhier believes, however, that they arise from the grey matter at the lower end of the medulla oblongata. Fasciculi teretes.

The mode in which the columns of the spinal cord are re-arranged so as to form those of the medulla oblongata, has been incidentally alluded to in the foregoing description; but the subject will be hereafter resumed in considering the internal structure.

Santorini, and subsequently Rolando, described a set of superficial white fibres on the fore part and sides of the medulla oblongata, crossing over it below the olivary bodies. From their direction they were named *fibræ vel processus arciformes*, fig. 167, *e*. They belong to a system of white fibres which pass transversely or horizontally, and consequently across the direction of the longitudinal columns already described. Part of them run from behind forwards in the median plane, forming a sort of septum between the lateral halves of the cord, and have been named *septal fibres*, fig. 178, *i*. It is probable that the arciform fibres are a continuation of these central fibres in front; and there Transverse white fibres of medulla oblongata. Arciform fibres. Septal fibres.

is also reason to suppose that they form the transverse medullary white striæ, in the floor of the fourth ventricle, which are connected with the origin of the auditory nerves, fig. 168,[7 7], and which will hereafter be described.

Transverse fibres are more or less apparent on surface.

Sometimes the greater part of the pyramidal and olivary bodies is covered by a thin stratum of these transverse fibres, which appear to issue from the anterior median fissure; but, most commonly, these superficial fibres appear only at the lower extremity of the olive, as the arciform fibres already mentioned. These differences are, most probably, owing not to the presence of the fibres at one time, and their absence at another, but to the circumstance of their running sometimes superficially, and at other times deeply in their transverse course.

THE PONS VAROLII, OR TUBER ANNULARE.

Pons Varolii;

its position;

named meso-cephalon, and nodus cerebri.

The *pons Varolii*, or *annular protuberance* (tuber annulare), fig. 167, *p*, fig. 169, *o*, is a comparatively small portion of the encephalon, which occupies a central position on its under surface, above and in front of the medulla oblongata, below and behind the crura cerebri, and between the middle crura of the cerebellum, with all which parts it is connected. From its position and connections it has been named méso-céphalon (Chaussier) and nodus encephali (Rau, Sœmmerring).

Its upper surface or back.

The under surface of the pons Varolii is of course seen in the base of the brain, fig. 169, *o*, whilst its upper surface, or the back, continuous with that of the medulla oblongata, forms part of the floor of the fourth ventricle, fig. 168.

Its under surface

forms annular protuberance or pons proper;

The under surface forms a white transverse quadrangular eminence, fig. 167, *p*, fig. 169, *o*, projecting in relief beyond the level of the medulla oblongata and crura cerebri, which, as we shall see, are connected with each other through its substance. It is this part, in particular, which is named the *annular protuberance*, because it embraces, as in a ring, the longitudinal portions of the nervous axis,—and also the *pons*, because, when viewed from below, it seems to cross over those parts like a bridge.

is striated across;

and grooved vertically.

It rests on the upper part of the basilar groove. It is marked with transverse bands and striæ, which indicate the course of its superficial fibres. Along the middle line it presents a shallow longitudinal groove which is wider in front than behind, and is prolonged over the anterior and

posterior borders of the pons. The basilar artery runs along this groove, in the floor of which are perforations for the transmission of small branches of that vessel.

The anterior and posterior borders of the pons are well defined. The anterior is more extended than the posterior, and its outline is more convex from side to side. Its borders defined;

The crura cerebri, fig. 169, *d*, *t*, appear to emerge from beneath it. At the sides, the limits of the pons Varolii are quite arbitrary, for it merely becomes narrower owing to its being gathered, as it were, into a compressed bundle on each side, *l*. These two bundles pass obliquely outwards and backwards into the cerebellum, and form its middle peduncles. at sides forms middle crura of cerebellum.

The substance of the pons Varolii consists of transverse and longitudinal white fibres interspersed with a quantity of diffused grey matter. The transverse fibres, with a few exceptions to be particularised hereafter, enter the cerebellum under the name of the middle crura or peduncles, and form a commissural system for its two hemispheres. The longitudinal fibres are those which ascend from the medulla oblongata into the crura cerebri, augmented, it would seem, by others which arise within the pons from the grey matter scattered through it. The arrangement of both these sets of fibres in the interior of the pons will be referred to hereafter; but we may notice now the layer of transverse fibres, fig. 167, which are next the surface. The fibres composing this layer do not all run parallel to each other. The middle fibres pass directly across, the lower set ascend slightly, whilst the upper fibres, which are the most curved, descend obliquely to reach the crura cerebelli on each side. There is always one superficial band, *i*, of the superior fibres, which crosses obliquely downwards over the middle and lower fibres, to gain the anterior surface of the corresponding crus. Structure: consists of longitudinal and transverse fibres with grey matter. Superficial transverse fibres.

THE CEREBRUM.

The *cerebrum* or brain proper, fig. 166, A, as already mentioned, is the highest, and by far the largest portion of the encephalon. It is of an ovoid shape, but is irregularly flattened on its under side. It is placed in the cranium with its small end forwards, its greatest width being opposite to the parietal eminences. Cerebrum;

The cerebrum consists of two lateral halves, or *hemi-* is divided into two

hemi-spheres; *spheres*, as they are called, which, though connected by a median portion of nervous substance, are separated in a great part of their extent by a fissure, named the great longitudinal fissure, which is seen on the upper surface of the brain and partly also upon its base, fig. 169, *a x b*.

surface covered with convolutions, and sulci; is grey externally. The cerebral hemispheres are not plain and uniform upon the surface, but are moulded into numerous smooth and tortuous eminences, named *convolutions* or gyri, which are marked off from each other by deep furrows, called sulci, or *anfractuosities*. These convolutions are coloured externally; for the surface of the cerebral hemispheres, unlike the parts hitherto described, is composed of grey matter.

Longitudinal fissure, between hemispheres. *Upper surface of the cerebrum.*—The *great longitudinal fissure*, seen upon the upper surface of the brain, extends from before backwards throughout its whole length in the median plane, and thus separates the cerebrum, as already stated, into a right and left hemisphere. On opening this fissure, it is seen, both before and behind, to pass quite through to the base of the cerebrum; but in the middle it is interrupted by a transverse portion of white substance, named the *corpus callosum*, fig. 170, *a b*, which connects the two hemispheres together. In the natural state, this fissure is occupied by a vertical process of the dura mater—the falx cerebri,—which dips down between the two hemispheres, not quite reaching to the corpus callosum.

Each cerebral hemisphere has an outer or convex surface, which is in contact with the vault of the cranium; an inner or flat surface, of a crescent shape, which forms one side of the longitudinal fissure; and an irregular under surface, which rests on the base of the skull, and on the tentorium cerebelli.

Under surface or base; divided into lobes: anterior, *Under surface of cerebrum.*—The under surface of each hemisphere, fig. 169, is marked off into three parts, called *lobes*, which are named according to their position, anterior, middle, and posterior, A B C, also *f g h*, fig. 166. The division between the anterior and middle lobes, which is very distinct, is indicated by a deep cleft, named the Sylvian fissure, *s s'*. There is no such evident demarcation between the middle and posterior lobes; but anatomists have considered, as the posterior lobe, that part of the hemisphere which lies over the cerebellum.* The under

* It is right to remark that some anatomical writers admit only *two* lobes, reckoning the middle and posterior lobes as a single one, under the name of the posterior lobe.

surface of the anterior lobe is triangular and excavated to adapt it to the roof of the orbit on which it rests. The middle lobe, fig. 166, *g*, is rounded and prominent, and occupies the middle fossa of the skull—the edge of the lesser wing of the sphenoid bone corresponding with the Sylvian fissure. The posterior lobe, *h*, is smooth and slightly concave on its under surface, where it rests on the arch of the tentorium. middle, and posterior lobes.

The Sylvian fissure, fig. 166, *e*, 169, *s s'*, which separates the anterior and middle lobes, passes at first upwards and backwards in the outer part of the hemisphere, and divides into two branches. At the entrance of the fissure is seen a bundle of white substance passing from the anterior to the middle lobe, named *fasciculus unciformis* (Reil). Sylvian fissure; Fasciculus unciformis.

On opening the fissure out, there is exposed to view a triangular prominent portion of the cerebral mass, named the *island of Reil* (insula). It is marked by small and short convolutions, which are sometimes called *gyri operti*, because in the natural state of the parts they are covered by the sides of the fissure. Island of Reil, or gyri operti.

It has already been stated that the entire surface of the cerebral hemispheres is marked by *convolutions* and sulci, some of which, it must not be forgotten, are concealed from view in the great fissures. These convolutions do not exactly resemble each other in all brains, nor are they symmetrical on the two sides of the same brain, although there is a certain correspondence in their general direction. Convolutions;

Each convolution may be described as presenting a summit or rounded free border, two sides, and a base, by which it is connected with the general cerebral mass. The outer portion of the convolutions (including, of course, the sides and bottom of the sulci) consists of a layer of grey matter, which is here called the *cortical substance* or *layer*: they are covered closely throughout by the pia mater, a vascular membrane, which sends processes down to the bottom of the sulci between them. These sulci are generally about an inch deep; but in this respect there is much variety in different brains, and in different parts of the same brain; in other words, the depth of the convolutions varies considerably: those upon the outer convex surface of the hemisphere are the deepest. In general, the depth of a convolution exceeds its width; and its width, near the summit, is greater than through its base. their form; structure; depth;

The free border of a large convolution, or the side of an subdivided

into smaller ones.

unusually deep one, is sometimes grooved longitudinally, or marked with shallow notches, so as to be partially divided into smaller or subordinate gyri. All the convolutions are continuous with each other if not upon the surface, at least within the anfractuosities; for, if one appears to end abruptly, it will be found on examination to sink between and then run into others, across the bottom of the intervening sulci.

Nature of convolutions.

Since the external grey or cortical substance is continuous over the whole surface of the cerebral hemispheres, being found alike within the sulci and upon the gyri, a far greater extent of grey matter is obtained with a given size of the organ than could have been the case had the hemispheres been plain and destitute of convolutions.

Arrangement, complex.

The general arrangement of the convolutions has been made the subject of study by various anatomists in earlier and recent times, but much yet remains to be elucidated. An attempt to describe individual gyri would be quite useless, owing to their irregularity in different cases, and their want of symmetry in the same brain. Nevertheless, there are some sufficiently constant in presence, and characteristic in situation and form, to admit of being specially described.

Their first appearance in animals.

It has also been shown that certain of the cerebral convolutions precede others in their appearance in the series of mammiferous animals; for in the lowest mammalia, and in all inferior classes of vertebrata, the cerebrum is not convoluted on the surface.

Convolutions of island of Reil.

Among the earliest convolutions to appear are those of the island of Reil, which are concealed in the Sylvian fissure. As seen in the human brain they radiate from the summit to the base of the triangular eminence formed by the island, and are separated by shallow sulci.

Convolution of Sylvian fissure.

Surrounding the convolutions of the island (gyri operti), and forming the lips of the Sylvian fissure, is a very large convolution, named *convolution of the Sylvian fissure.* This is also early in its appearance in animals: in them it is, at first, simple in form, and completely surrounds the fissure, forming a curve, open in front and below. In the human brain, fig. 169, *f f*, it is tortuous and much folded, so as to form many subordinate gyri, corresponding with the front, upper, and under border of the fissure. The commencement of this convolution, *f*, in front of the fissure, forms the outer part of the triangular orbital surface of the

anterior lobe. From its outer border proceed numerous secondary gyri, which extend in various directions on the convex surface of the hemisphere, fig. 166; and its inner border receives, in a similar manner, the radiating convolutions of the island of Reil.

Perhaps the most distinct and symmetrical convolution in the whole brain is that named the *internal convolution, convolution of the corpus callosum, gyrus fornicatus.* Commencing (fig. 170, *h*) on the under surface of the brain, immediately before the part named the anterior perforated space, it ascends a short distance in front of the anterior recurved extremity of the corpus callosum, *a*, and then runs backwards, *h'*, immediately above that body, as far as its posterior extremity: there it turns downwards and forwards, *h''*, embracing the cerebral peduncle, fig. 169, *t*, to reach the entrance of the Sylvian fissure, *h'*. This long convolution, therefore, describes a sort of ring open or interrupted opposite the Sylvian fissure, and embracing the corpus callosum above, and the cerebral peduncle below. It thus occupies the entire margin of the convoluted surface of the hemisphere, and, as was pointed out by Foville, forms a sort of rim or border to the grey matter, whence it is named by him *convolution d'ourlet.* The surface of this convolution, especially towards its termination below, is covered by a very thin cribriform layer of white substance, which, with the grey matter beneath, gives the surface a mottled aspect. This has been called the *reticulated white substance.* The gyrus fornicatus is variously grooved in different brains, and from its upper border are given off secondary gyri, which extend in different directions upon the inner or flat surface of the hemisphere, fig. 170. From the appearance of the convolution and its offsets in this situation, the name *processo cristato* was applied to it by Rolando.

Gyrus fornicatus; embraces corpus callosum; forms the border of grey matter; is covered by reticulated white substance; forms the crest of Rolando.

Another large convolution may be traced, according to Foville, more or less indented or interrupted, however, in its course, along the line of junction between the convex and flat surfaces of the hemisphere,—in other words, along the corresponding lip of the great longitudinal fissure. This, which might be called the *marginal convolution of the longitudinal fissure*, commences on the under surface of the brain (figs. 169, 170, *x*), in common with the gyrus fornicatus, and passing forwards, forms the inner border of the triangular orbital surface of the anterior lobe, and is here

Marginal convolution of the longitudinal fissure; its course along the border of fissure;

cleft as it were into two by a deep sulcus, into which the olfactory nerve, 1, is received. Turning next over the front and upper surface of the cerebrum, it may generally be traced for some distance along the margin of the longitudinal fissure, $x' x''$, but soon becomes marked by deep sulci; and thus interrupted, may be followed round the posterior extremity, y, and afterwards along the under surface of the hemisphere forwards as far as the point of the middle lobe, running parallel for some space with the under portion of the gyrus fornicatus.

its termination at point of middle lobe.

Supra-orbital convolutions.

The convolutions on the under surface of the anterior lobe have been usually mentioned separately by anatomists. The outer border, fig. 169, of this triangular surface is formed by the commencement of the convolution of the Sylvian fissure, f; the inner border, x, by the marginal convolution of the longitudinal fissure, in the sulcus on which the olfactory nerve is lodged. The intermediate excavated part is occupied by other convolutions, less regular in their direction. At the apex of the triangle behind, the two borders are connected by a short and but slightly elevated convolution, s, which bounds the anterior perforated space in front.

Convolutions on outer surface of cerebrum:

large, complex, and unsymmetrical.

It remains only to notice those gyri which occupy the outer or convex surface of the hemisphere, between the marginal convolution of the longitudinal fissure and that of the Sylvian fissure. The general direction of these, see fig. 166, $f\ h\ g$, which are the largest, the most complicated, and the least symmetrical of all the convolutions of the human brain, is not longitudinal, like those previously described, but transverse or somewhat oblique. It has been remarked by Foville that they frequently become branched like the letter Y, as they proceed upwards and backwards towards the longitudinal fissure.

Foville's four orders of convolutions.

M. Foville considers that the convolutions may be arranged into four principal groups or orders, founded in a great measure on their relative connections with the anterior perforated space, which, in his estimation, is a part of the highest importance.

First includes gyrus fornicatus and another.

The *first* order issues from the perforated space, and consists of two portions. One, large and vertical, is the gyrus fornicatus, minus its ascending secondary gyri; the other short, and horizontal, is the slightly-elevated ridge which bounds the perforated space in front and on the outer side.

Second includes convolutions of longitudinal and Sylvian fissures.

The *second* order, also consisting of two portions, commences from the horizontal portion of the first order on the limits of the perforated space. One part corresponds with the marginal convolution of the longitudinal fissure, as already described, except that part

of it on the orbital surface of the anterior lobe which lies to the outer side of the olfactory sulcus; the other part is the convolution of the Sylvian fissure.

The *third* order consists of two sets, of which one occupies the inner surface of the hemisphere, and connects the gyrus fornicatus in its whole length with the marginal convolution of the longitudinal fissure; the other set lies in the Sylvian fissure, forms the island of Reil, and connects the short horizontal portion of the first order with the convolution surrounding that fissure. Third are internal convolutions and those of island of Reil.

The convolutions of the *fourth* order, the largest, deepest, and least symmetrical of all, are quite detached from the perforated space, and have no relation to the first order of convolutions. They connect the two convolutions of the second order together, viz., the marginal convolution of the median fissure and that of the Sylvian fissure, and occupy the outer or convex surface of the cerebral hemisphere. Fourth, occupy outer surface of brain.

M. Leuret has arrived at some interesting conclusions in reference to the cerebral convolutions in mammalia, which class of animals are arranged by him, in connection with this point, into as many as fourteen groups. Leuret's views; founded on anatomy of convolutions in mammalia;

In the lowest group—represented by the bat, mole, rat, &c.—the cerebral hemispheres, as in birds, are quite plain and smooth, though divided by a Sylvian fissure. In the second group—including the rabbit, beaver, and porcupine—that fissure is more strongly marked; but there are only a few slight depressions on the surface of the hemispheres, indicating the future sulci between the convolutions. at first none;

In the third group—formed by the fox, wolf, and dog—the simplest form of true convolutions is first met with; and they are named by M. Leuret, *fundamental convolutions*. In the brain of the fox, taken as a typical example, they are six in number: they are all simple in outline, distinct from each other, and form a series of longitudinal curved lines on the surface of the hemisphere, running from before backwards. earliest appearance. Fundamental convolutions run lengthwise;

Four of them, named *external*, are placed on the convex surface of the hemisphere. Of these, one forms the curved lip or border of the Sylvian fissure, and surrounds the island of Reil; the other three, also curved in this direction, are placed parallel with the first, and one above another,—the fourth, or *superior* convolution, being placed on the margin of the longitudinal fissure. The fifth convolution, (*anterior*) forms the under and fore part of the anterior lobe, and is named the supraorbital convolution. The sixth (*internal*) is placed above the corpus callosum, and corresponds with the gyrus fornicatus. external, anterior, and internal.

In the succeeding groups, up to the thirteenth, various changes take place in the condition and mode of connection of these fundamental convolutions, which cannot be detailed here. Thus, in all cases excepting in the feline tribe, they are reduced in number to five, or four—the reduction affecting the external convolutions. In some cases they are bifurcated at certain points, or marked by divisions or depressions, or they are undulated in their course. Lastly, they are very commonly united, at more or less frequent intervals, by short *supplementary* convolutions. Modified in number, complexity, and union by supplementary ones.

In the brain of the elephant (which stands in the thirteenth group) M. Leuret recognises another additional set of convolutions, which have a more decidedly transverse direction than the short supple- Higher in the scale; additional system of

transverse gyri.

mentary convolutions above alluded to. These new convolutions (*superior transverse*), forming two rows and separated by a groove, occupy the upper and outer part of the hemisphere, and cross or interrupt, as it were, the fundamental longitudinal convolutions.

In the last group (that of the monkeys) these *superior* transverse convolutions, forming two distinct rows, separated by an intermediate groove, are still more evident.

Fundamental.

In the human cerebrum, M. Leuret, by help of a comparison between the brain of the fœtus and the adult, has represented three external fundamental convolutions, which are tortuous, and frequently communicate with each other. Besides these, there is the internal convolution (gyrus fornicatus) and supraorbital convolution (?).

Transverse convolutions in human brain.

Between the anterior and posterior portions of the three external convolutions are interposed, on the upper surface of the brain, two sets of *transverse* convolutions, divided by a distinct sulcus, which runs outwards and forwards from the longitudinal fissure, so that the right and left grooves form a V-shaped line, open in front. This fissure, also noticed in the brains of the elephant and monkey, is stated by Leuret to be very constant, and is named by him the fissure of Rolando.*

Fissure of Rolando.

General inference concerning the convolutions most characteristic of man.

From the preceding account of the cerebral convolutions, it would appear that those situated upon the outer or convex surface of the hemisphere—the fourth order of M. Foville, and the superior transverse convolutions of M. Leuret—attain their highest development in man, and are indeed particularly characteristic of the human brain. To this peculiarity, however, must be added the elongation of the cerebrum backwards by the increased development of the posterior lobe, and the greater complexity of the vertical convolutions in the median fissure, and of those of the island of Reil.

Base of cerebrum.

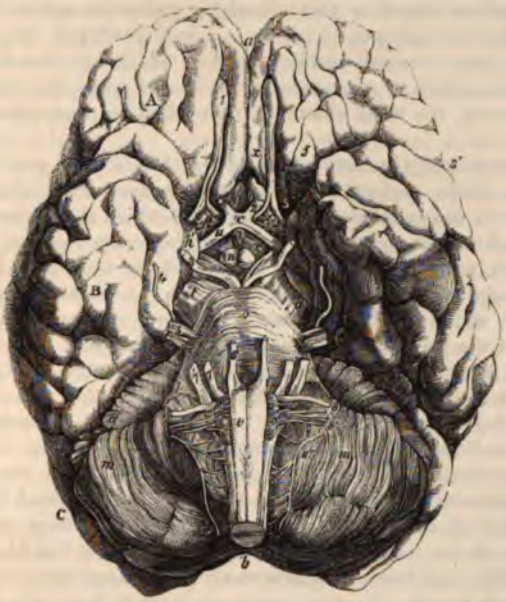
Base of the cerebrum, fig. 169.—When the brain is turned with its base uppermost, and the parts of which it is composed are allowed to fall asunder by their own weight, two large bundles, *d*, *t*, consisting of white substance externally, are seen to emerge together from the fore part of the pons Varolii, *o*, and, separating from each other as they proceed forwards and outwards, to enter the inner and under part of the right and left cerebral hemispheres. These white bundles, which are marked on the surface with longitudinal

Cerebral peduncles or crura.

* In the Hunterian Lectures for 1842, Professor Owen gave the results of his observations on the comparative anatomy of the convolutions. He had previously, in 1833, called attention to this study as a means of determining "the amount and locality of the convolutions of the human brain, which are analogous to those of the lower animals." On the anatomy of the Cheetah; Zoological Transactions, vol. i.

striæ, are the *peduncles* (crura) of the cerebrum. Just before entering the corresponding hemisphere, each is crossed by a

Fig. 169.*



flattened white cord, named the *optic tract*, *u u*, which, Optic tract.

* Shows the under surface or base of the encephalon freed from its membranes.—A. anterior, B. middle, and C. posterior lobe of cerebrum. —*a*. The fore part of the great longitudinal fissure. *b*. Notch between hemispheres of cerebellum. *c*. Optic commissure. *d*. Left peduncle of cerebrum. *e*. Posterior perforated space. *e* to *i*. Interpeduncular space. *f f*. Convolution of Sylvian fissure. *h*. Termination of gyrus fornicatus behind the Sylvian fissure. *i*. Infundibulum. *l*. Right middle crus or peduncle of cerebellum. *m m*. Hemispheres of cerebellum. *n*. Corpora albicantia. *o*. Pons Varolii, continuous at each side with middle crura of cerebellum. *p*. Anterior perforated space. *q*′. Horizontal fissure of cerebellum. *r*. Tuber cinereum. *s s*′. Sylvian fissure. *t*. Left peduncle or crus of cerebrum. *u u*. Optic tracts. *v*. Medulla oblongata. *x*. Marginal convolution of the longitudinal fissure.—1 to 9 indicate the several pairs of cerebral nerves, numbered according to the usual notation, viz. 1. Olfactory nerve. 2. Optic. 3. Motor nerve of eye. 4. Pathetic. 5. Trifacial. 6. Abducent nerve of eye. 7. Auditory, and 7′. Facial. 8. Glosso-pharyngeal, 8′. Vagus, and 8″. Spinal accessory nerve.

missure, this fissure is crossed by a white transverse mass, which is the anterior recurved extremity of the corpus callosum. On gently turning back the optic commissure, a thin connecting layer of grey substance, the *lamina cinerea*, fig. 170, behind *h*, is seen proceeding backwards from the corpus callosum to the commissure, to become continuous (supposing the parts in their natural position) above the commissure with the grey matter of the tuber cinereum. This thin grey layer, which is also connected at the sides with the grey substance of the anterior perforated space to be presently described, forms part of the anterior boundary of the third ventricle: it is very generally torn in removing the brain from the skull; and in that case, an aperture is made into the fore part of the third ventricle.

Lamina cinerea; is often torn.

In front of the optic tract, and near the entrance of the Sylvian fissure, there is situated a greyish quadrangular space on each side, named the *anterior perforated space* (locus perforatus anticus), fig. 169, *p p*.

Anterior perforated space: boundaries;

Each anterior perforated space is bounded in front by the convolutions of the anterior cerebral lobe, on which are seen the roots of the olfactory nerve, 1; behind, by the optic tract; on the outer side, by the middle lobe, and the commencement of the Sylvian fissure; and on the other side, by the median fissure and the lamina cinerea. It is placed immediately beneath the corpus striatum, a large mass of grey matter in the interior of the brain, to be hereafter noticed. The grey surface of each perforated space is crossed by a broad white band, which may be traced from the middle of the under surface of the corpus callosum in front, backwards and outwards along the side of the lamina cinerea towards the entrance of the Sylvian fissure. These bands on the two sides are named the *peduncles of the corpus callosum*. The anterior perforated space, especially that part of it next the Sylvian fissure, is pierced with a multitude of small holes for the passage of blood-vessels, most of which are destined for the corpus striatum.

lies beneath corpus striatum.

Peduncles of the corpus callosum.

When the entire encephalon is viewed from below (as in fig. 169), the back part of the under surface of the cerebrum is concealed by the cerebellum, *m*, and the pons Varolii, *o*. If, however, these parts be removed, it will be seen that the two hemispheres of the cerebrum are separated behind as they are in front, by the descent of the great longitudinal fissure between them, and that this fissure is arrested by a cross mass of white substance, forming the posterior end of

Hind part of longitudinal fissure.

the corpus callosum. This posterior part of the great longitudinal fissure is longer than the anterior portion.

INTERNAL PARTS OF THE CEREBRUM.

Having completed the survey of the parts seen externally upon the cerebrum, we proceed to examine its internal anatomy. This will be more readily understood in detail, if some general idea be previously obtained of it.

General idea of cerebrum; its hemispheres and their modes of connection; and the ventricular space.

The hemispheres, it will be remembered, are connected together in the middle by the corpus callosum, and it is obvious that the structures filling up the interpeduncular space serve also as connecting media. Between the corpus callosum above and the peduncles below, the two hemispheres are partially separated from each other, so as to leave an interval, the general ventricular space, across which some slighter connecting portions of nervous substance pass from one hemisphere to another.

Again, as seen on a transverse vertical section of the cerebrum, fig. 181, the peduncles *b*, *g*, diverge as they ascend towards the hemispheres, and pass on each side through two large masses of grey matter, sometimes called ganglia of the brain,—at first through the thalamus opticus, *l*, and afterwards through a much larger mass named corpus striatum, *k*. These two masses of grey matter project somewhat, as smooth convex eminences, on the upper and inner surface of the diverging fibres of the peduncles. Immediately above the thalami and corpora striata, the hemispheres are connected together across the median plane by the corpus callosum, *q*; and it is between the under surface of the latter, *s*, and the upper surface of the eminences mentioned and the interpeduncular structures, that the general ventricular space is situated in the interior of the cerebrum. The upper part of this space is again divided by a median vertical partition, so as to form the two lateral ventricles: below this it forms a single cavity named the third or middle ventricle, which communicates with both the lateral ventricles above, and, below, with the ventricle of the cerebellum or fourth ventricle. The median vertical partition, which separates the lateral ventricles from each other, consists at one part (septum lucidum) of two layers, between which is contained the fifth and remaining ventricle of the brain.

Ventricular space; how divided into five cavities or ventricles.

Use of sections.

The anatomy of these parts is conveniently studied by

removing successive portions of the hemispheres by horizontal sections, beginning from above.

First section of hemispheres from above. White and grey matter exposed.

The first horizontal section to be made about half an inch above the corpus callosum, displays the internal white matter of each hemisphere, speckled with red spots where its blood-vessels have been divided, and surrounded on all sides by the grey matter which is seen to follow accurately the convoluted surface, and to be of nearly equal thickness at all points. This white central mass in each hemisphere was named by Vicq-d'Azyr the *lesser oval centre* (centrum ovale minus). On separating the remaining portions of the two hemispheres from each other, it is seen that they overlap the corpus callosum for some distance at each side. These projecting margins of the hemispheres, which are, in fact, part of the gyrus fornicatus, on each side, have been named *labia* cerebri, and the spaces covered in by them, the *ventricles of the corpus callosum*,—though these parts do not seem to need any special designation.

Borders of hemispheres overhang corpus callosum.

Next section.

The hemispheres being in the next place sliced off down to the level of the corpus callosum, the white substance of that part is seen to be continuous with the internal medullary matter of both hemispheres: and the large white medullary mass thus displayed, surrounded by the border of cortical substance, constitutes what is generally described as the *centrum ovale* of Vieussens.

Centrum ovale of Vieussens.

External or cortical substance, arranged in several layers.

It may here be stated generally, that the grey matter of some of the convolutions in the posterior part of the brain, consists, as seen on a section, of an external darker and an internal light layer, fig. 171, *r*. This appearance is usually well marked on the inner or flat surface of the posterior lobe. Some authors (Baillärger, Remak, Todd, and Foville) describe several alternate white and grey layers in the cortical substance of many of the convolutions. These strata are described further on.

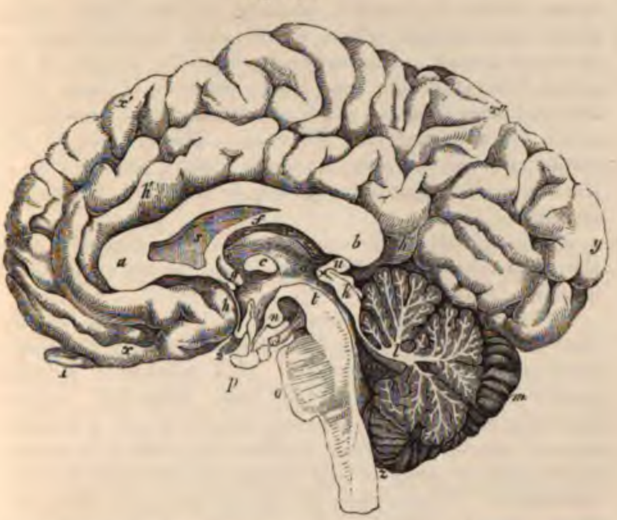
Corpus callosum:

great commissure of cerebrum; its dimensions;

The *corpus callosum*, (seen in section, fig. 170, *a*, *b*,) which is now supposed to be completely exposed above, also named the beam of the brain (trabs cerebri) and *great commissure*, is the cross portion of white substance which lies between the hemispheres at the bottom of the longitudinal fissure. It is three inches and upwards in length, and extends further forwards than backwards, reaching to about an inch and a half of the anterior, and not quite two inches and a half of the posterior extremity of the cerebrum. It is about eight or ten lines in width behind, and somewhat

narrower in front. Its thickness, which can only be seen on a vertical section, fig. 170, is greater at the ends than

Fig. 170.*



in the middle, and is greatest behind, where it amounts to three lines. In form it is somewhat arched from before

* A vertical section in the median plane, of the cerebrum, cerebellum, pons, and medulla oblongata—the parts being all represented in their natural position. (After Sœmmerring.) *a*. Anterior, and *b*. Posterior extremity of corpus callosum, which is seen in section. *d*, *c*, *e*. Third ventricle. *c*. Soft commissure. *d*, *e*. Thalamus opticus, forming side of third ventricle. *f*. Fornix, united behind to corpus callosum. *g*. Anterior pillar of fornix. Between *g* and *h*, anterior commissure. Behind *h*, lamina cinerea. *h h′ h″*. Convolution of corpus callosum or gyrus fornicatus. *i*. Infundibulum. *k*. Corpora quadrigemina, seen in section. *k* to *l*. Valve of Vieussens. *l*. Section of cerebellum, showing white and grey matter—appearance named arbor vitæ. *m*. Notch of cerebellum. *n*. Corpus albicans of right side. *o*. Pons Varolii (section). *p*. Pituitary body. *r*. Choroid plexus. *s*. Septum lucidum. *t*. Cerebral peduncle of right side in section. *u*. Pineal gland. *v*. Cavity of fourth ventricle. *d* to *v*. Iter a tertio ad quartum ventriculum, or aqueduct of Sylvius. *x x′ x″*. Marginal convolution of the longitudinal fissure. *y*. Posterior lobe of cerebrum. *z*. Opening leading into fourth ventricle. 1. Olfactory nerve. 2. Optic nerve divided through optic commissure. 3. Third nerve, or motor oculi.

backwards. Its upper surface, (partly seen at fig. 171, *d*,) is deeply marked by transverse fasciculi, which indicate the cross direction of the greater number of its fibres. Along the middle line is seen a line or mark, called the *raphe* or seam, which is bounded laterally by two white tracts, placed close to each other, named *striæ longitudinales*, or *nerves of Lancisi*. On each side, near the margin of the gyrus fornicatus, are seen other longitudinal lines (striæ longitudinales laterales) which are occasioned by a few scanty white fibres having that direction. The arteries of the corpus callosum run along its upper surface, and the edge of the falx cerebri approaches closely to it behind, though not in front.

consists of cross fibres: the raphe, striæ longitudinales, and striæ longitudinales laterales.

Corpus callosum is continued laterally into hemispheres; its anterior border or genu; its beak; its peduncles.

At the two sides, the corpus callosum is connected with the white substance of the hemispheres by an extension of its fibres into them.

In front it is reflected downwards and backwards, between the anterior lobes, towards the base of the brain, forming a bend named the knee (genu), *a*. The inferior or reflected portion, which is named the beak (rostrum), becomes gradually narrower as it descends (behind *h*). It is attached at each side to the anterior cerebral lobe, and is connected at its point by means of the lamina cinerea with the optic commissure. It also gives off the two bands of white substance, already noticed as the *peduncles* of the corpus callosum, which, diverging from one another, run backwards across the anterior perforated space on each side to the entrance of the Sylvian fissure.

Posterior extremity is thick.

Behind, the corpus callosum terminates in a free thickened border (*bourrelet*), the under surface of which is also free for a little distance forwards.

Connections below to other parts;

The under surface of the corpus callosum is connected behind with the fornix, *f*, a structure to be presently described, and in the rest of its length with the septum lucidum, *s*, the vertical partition between the lateral ventricles.

its structure; why thicker at the ends.

Although it presents a few longitudinal white fibres on its surface, the corpus callosum consists almost entirely of fibres having a transverse course towards each side, and spreading in all directions into the substance of the two hemispheres. Only the median portion of these fibres between the hemispheres is seen without dissection. As the transverse fibres from the anterior and posterior lobes of the cerebrum are necessarily aggregated in large numbers near the corresponding ends of the corpus callosum, its relative thickness

at those points, in comparison with the rest of its extent, is accounted for ; and since the posterior lobe reaches further beyond the corpus callosum than the anterior, the greater thickness behind is also explained.

By dividing the fibres of the corpus callosum in a longitudinal direction at a short distance on each side of the middle line, and about midway between the two ends of the hemispheres, an opening is made into the right and left *lateral ventricles* of the brain. These ventricles form part of the general ventricular space within the cerebrum ; they are serous cavities, and are lined by a delicate epitheliated membrane, which at certain parts in the adult, and in the fœtus, probably throughout its whole extent, is provided with cilia. In the natural state, their walls are moistened internally with a serous fluid, which sometimes exists in considerable quantity, even in a healthy brain.

Lateral ventricles; how exposed; are lined by serous membrane, ciliated; contain fluid.

Henle states that the lining membrane of the ventricles consists of epithelium only, which lies immediately on the nervous matter. Kölliker states that a filamentous layer is very frequently present, and over some parts may be considered constantly present. We have once observed an appearance unfavourable to the view of Henle. In the instance in question, the membrane over the surface of the corpora striata and adjacent parts was raised into small vesicular elevations by a clear fluid,—an appearance which was most probably due to a plexus of lymphatic vessels distended with lymph.

The part of the lateral ventricles which is laid open by the steps already indicated, is named the *centre* or *body ;* from this point each ventricle is extended in three directions, forming so many prolongations named *horns* (cornua), which may be displayed by carefully slitting up and removing the white medullary substance of the hemisphere which covers them in. From the direction taken by these cornua, they are named the anterior, posterior, and middle or descending cornua ; and the lateral ventricles themselves are named *ventriculi tricornes.* The *anterior cornu*, fig. 171, *g*, passes forwards and outwards in the substance of the anterior lobe *;* the *posterior cornu*, *h*, backwards, outwards, and inwards in the posterior lobe ; and the *descending cornu*, *q*, which traverses the middle lobe, passes at first, backwards, outwards, and downwards, and then changing its course, runs forwards and inwards nearly to the point of the middle lobe. The posterior cornu, also named the *digital cavity*, is very variable in extent, even in the two sides of the same brain.

The body, and three horns or cornua. Ventriculi tricornes; directions of cornua; digital cavity.

The parts forming the boundaries of the lateral ventricles, and those seen within them, may be first enumerated, and will afterwards be described in detail.

Fig. 171.*

Parts contained in body of ventricle.

The *body* of this ventricle is covered in by the corpus callosum, which is therefore said to form its roof. On the inner side in the median plane is a vertical partition, the *septum lucidum*, fig. 170, *s*, which descends between the two lateral ventricles, from the under side of the corpus callosum, to the fornix. The *fornix*, *f*, itself, attached to

* Section of cerebrum, displaying the lateral ventricles.—On the right side the descending cornu is laid open. *a*, *b*. Parts of great longitudinal fissure. *c*. Section of front of corpus callosum. *d*. Part of posterior end of the same. *e*. The left choroid plexus. *f*. The body of the fornix. *g*. Anterior cornu, *h*, posterior, and *q*, descending cornu of the lateral ventricle. *kk*. Corpora striata. *ll*. Optic thalami. *nn*. Right and left hippocampus minor. *o*. Posterior pillar of fornix becoming continued as the corpus fimbriatum, *v*. *q*. Cornu ammonis, or Pes hippocampi. *r*. Shows alternate grey and white layers in cortical substance. *ss*. Right and left tænia semicircularis. *v*. Corpus fimbriatum. *y*. Eminentia collateralis.

the lower edge of the septum, is partly seen in the floor of this part of the ventricle. Appearing from below the outer margin of the fornix is seen a red vascular fringe, the *choroid plexus*, *e*, next to that a portion of the upper surface of the *thalamus opticus*, *l*. Beyond the thalamus is the *corpus striatum*, *k*, and between the two last-named parts is a narrow tape-like band, *tænia semicircularis*, *s*. On the outer side of the corpus striatum we arrive again at the under surface of the corpus callosum.

Parts in anterior cornu. The anterior cornu is also covered in by the corpus callosum; it turns round the anterior free extremity of the corpus striatum, descending as it proceeds, and is bounded behind by that body, and in front by the reflected part of the corpus callosum.

Parts in middle cornu. The middle or descending cornu turns round the back part of the optic thalamus which appears in its cavity, and forms its anterior boundary. It is covered in by the thalamus, and by the medullary substance of the middle lobe. The principal object seen upon its floor is a long curved eminence, which follows the direction of the cornu towards its anterior extremity, and is notched, or indented on its surface; this is the *hippocampus major*, *q*. Along the inner edge of this eminence is seen a narrow white band, named *corpus fimbriatum*, *v*, which is prolonged from the fornix; to the inner side of that is a part of the choroid plexus, *e*, and next to that the back of the optic thalamus.

Parts in posterior cornu. The posterior cornu seems, as it were, scooped out of the substance of the posterior lobe. The choroid plexus does not enter it. On its floor is seen a longitudinal ridge, named *hippocampus minor*, or *ergot*, *n*; and at the junction of the posterior with the descending cornu, between the hippocampus major and minor, is a smooth eminence, which varies much in size, named *eminentia collateralis*, *y*.

Septum lucidum; separates lateral ventricles; The *septum lucidum* is a thin translucent partition (fig. 170, *s*), placed between the two lateral ventricles. It extends vertically between the corpus callosum above, and the anterior part of the fornix below; and as the latter sinks down in front away from the corpus callosum, the septum is somewhat triangular in form, being deep before and narrow behind. The septum lucidum is attached above, in front, and for a certain space below, to the corpus callosum, fitting in, as it were, into its anterior reflected portion. Below and further back it is attached to the fornix.

is double, This vertical septum is double, being composed of two

perfectly distinct laminæ, having an interval between them, which contains fluid, and is lined by an epitheliated membrane. This is the *fifth ventricle*, *ventricle of the septum*, or *Sylvian ventricle*. It may be laid open by cutting through the corpus callosum, and detaching it for a certain distance from the upper border of the septum (as in fig. 171). In the human embryo, and also in some animals, the cavity of this ventricle communicates with that of the third ventricle in front and below; but in the adult human brain it forms a separate and insulated cavity. Tarin described a small fissure in it between the pillars of the fornix; but this is unusual. In disease it is sometimes distended with fluid.

and contains fifth ventricle, which is a distinct cavity.

Structure of septum lucidum. Each of the laminæ of the septum which form the sides of the fifth ventricle, consists of an internal layer of white substance and an external layer of grey matter.

Fornix; its shape and position; consists of two parts; The *fornix* is a white longitudinal band, extending along the lower edge of the septum lucidum, and attached behind to the under surface of the corpus callosum. It appears in the floor of both lateral ventricles, fig. 171, *f*, *o*, and dips downwards at each extremity, fig. 170, *f*, but rises in the middle so as to form a sort of vault or arch (fornix), which is free on its under surface. It may be described as consisting of two lateral halves, which are separated from each other in front and behind, but between those points are joined together in the median plane. The two parts in front form the anterior pillars of the fornix; the middle conjoined part is named the body; and the hind parts, which are again separated from each other, form the posterior pillars.

its body is triangular. The *body* of the fornix, fig. 171, *f*, is triangular in shape, being broad and flattened behind, where it is connected with the under surface of the corpus callosum, and narrower in front as it dips down to leave that body,—the space between them being filled up by the septum lucidum. Its lateral edges are in contact with the choroid plexuses, and its under surface rests upon a membrane, which connects those two plexuses together (velum interpositum).

Anterior pillars of fornix; descend to corpora albicantia, and then turn up into thalamus. The *anterior crura* or *pillars* of the fornix, figs. 173, 174, *f*, consisting entirely of white fibres, descend slightly apart from each other through a quantity of grey matter on the sides of the third ventricle, fig. 183, *t'*, as far as the corpora albicantia, *n*, where they turn up and enter the substance of the corresponding optic thalamus. The external or white portion of each of the corpora albicantia is

composed of the fibres of the corresponding pillar of the fornix, which there forms a twisted loop. These pillars might therefore be described as commencing in the substance of the thalami, descending into the corpora albicantia, in which they are twisted in the manner described, then rising up through the grey matter on the sides of the third ventricle, becoming free above, and at length joining together to form the body of the fornix. They are connected with the peduncles of the pineal gland, and with the tænia semicircularis, as will be afterwards described.

Foramen of Monro; is behind pillars of fornix;

Immediately behind the anterior pillars of the fornix, a small opening is seen on either side. The two openings pass downwards and backwards towards the middle line, and meeting below, lead into the upper part of the third ventricle. The passage thus formed is the *foramen of Monro*. It is single below, where it communicates with the third ventricle, but divides above, somewhat like the letter Y, into two branches, one to each lateral ventricle. In this way it will be seen that all three ventricles communicate with each other at this point.

is single below and double above.

Posterior pillars of fornix,

The two flat bands into which the fornix divides behind are its *posterior pillars*, or *crura*, fig. 171, *o*. Adhering at first to the under surface of the corpus callosum, they pass backwards diverging from each other; and then leaving the corpus callosum, turn suddenly downwards into the descending cornu of the corresponding lateral ventricle, where we shall presently follow them. On dividing the fornix across in front, and turning it back with the corpus callosum, so as to expose the under surface, a triangular portion of the latter, fig. 173, *e*, is seen between the diverging posterior crura of the fornix, marked with lines, some of which are transverse, but others longitudinal or oblique. To this part the term *lyra* has been applied.*

in descending cornu.

Hippocampus minor.

In the posterior cornu of the lateral ventricle we have to examine the *hippocampus minor*, 171, *n*, also called the

* The varying direction of these lines has been represented by Vicq-d'Azyr, who attributes them to the impression of the vessels of the subjacent velum interpositum. The term *corpus psalloides* given by the early anatomists to the fornix, in consequence of its resemblance to an arch (ψαλλιδοειδῆς—Galen; from ψαλις or ψαλλις, fornix, an arch), was erroneously interpreted by Winslow and others, who suppose that it meant something which had the appearance of a harp or similar stringed instrument, and that it was intended specially to designate the part marked with the linear impressions described, which accordingly was named *lyra* and *psalterium*.

ergot or *calcar avis*, from its resemblance to a cock's spur. It is a white eminence pointed at its posterior extremity, forming a relief along the inner side of the cornu: beneath the white surface it consists of grey matter, which is part of the cortical substance of the hemispheres, corresponding with the bottom of a sulcus seen on the inner surface of the posterior lobe.

Hippocampus major. The *hippocampus major* (pes hippocampi; or cornu ammonis, from its resemblance to a ram's horn) is a large white eminence, *q*, already mentioned as lying along the floor of the descending cornu of the lateral ventricle. Behind the pes, and between it and the hippocampus minor, is

Eminentia collateralis. another white eminence known as the *eminentia collateralis, pes accessorius*, *y*, which has a similar relation to a convolution as the lesser hippocampus, and is often as large as, or

Hippocampus, indented or notched. larger than that elevation. The hippocampus major becomes enlarged towards its anterior and lower extremity, and is indented or notched on its edge, so as to present some resemblance to the paw of an animal, whence, no doubt, its name of pes hippocampi.

The external white substance of the hippocampus major is partly derived from the posterior pillar of the fornix, which, as already stated, enters the descending cornu of the lateral

Posterior pillar of fornix is prolonged as corpus fimbriatum. ventricle. The remaining part of that pillar forms a white band, like a tape, which is attached along the inner border of the great hippocampus and forms the *tænia hippocampi* or *corpus fimbriatum*, *v*. It reaches down to the end of the pes, but its further connections are not well known.

Along the inner border of the corpus fimbriatum, (which is a continuation of the posterior pillar of the fornix,) and between it and the thalamus, is the prolongation of the choroid plexus, *e*, occupying in this situation a part of the transverse fissure to be presently described. On separating the corpus fimbriatum from the plexus, and raising the edge of the former, we discover a grey indented ridge, which runs parallel with it, but which, strictly speaking, is situated

Fascia dentata. outside the cavity of the cornu. This is the *fascia dentata*, fig. 172, *c*.

Structure of the hippocampus major. The structure of the pes hippocampi is best examined by making a cross section through it. It will then be seen that its surface is composed of white substance, fig. 172, *a*, which is continuous with that of the corpus fimbriatum.

Internal grey matter is curled up. Within, it contains a stratum of grey matter, *b*, doubled on itself, and continued from the cortical substance on the

adjacent convolution of the middle lobe (part of the gyrus fornicatus). This grey layer accompanied by a thin coating of white matter, *d*, already described in this situation as the reticulated white substance (see p. 455), is first bent inwards, and then curls outwards upon itself, so as to terminate by a free indented edge, which appears at the surface as the fascia dentata, *c*.

Fig. 172.*

From what has preceded, it will have been understood that the fornix is applied in nearly its whole length to the optic thalamus of each side—the body of the fornix, fig. 171, *f*, resting on the upper surface of the thalamus, *l*, and each posterior pillar being applied to the posterior surface of that body in the descending cornu. On separating these two parts it will be seen that a fissure exists between them. This is named the *transverse fissure of the cerebrum*. Through it the pia mater, from the exterior of the brain, passes into the ventricles to form the choroid plexuses. This fissure runs downwards and forwards into each descending cornu; it therefore extends from the point of the descending cornu of one side to that of the other, reaching as far forwards as the foramen of Monro, its extent corresponding exactly with that of the choroid plexuses. It is closed on the inner side by the lining membrane of the lateral ventricle, which is said to pass from the fornix to the thalamus over the choroid plexus.

Great transverse fissure of cerebrum; how formed; gives passage to pia mater; is closed by ventricular membrane.

On raising up the fornix, it will be seen that it rests on a vascular membrane which is interposed between it and the parts beneath. This is named the *velum interpositum* or *tela choroidea*, fig. 173, *v*. It connects the choroid plexuses of the two sides together, and like them is a prolongation of the pia mater. This last-named membrane passes from the outer surface of the brain underneath the corpus callosum and fornix, and above the corpora quadrigemina, the pineal gland and the thalami, through the transverse fissure into the lateral ventricle. The membranous prolongation thus

Velum interpositum, or tela choroidea; connects the choroid plexuses.

* Section of the hippocampus major, to show the arrangement of its grey and white substance. *a*. White layer on its surface. *b*. Grey substance which becomes rolled up. *d*. White reticulated substance, on the surface of gyrus fornicatus. *c*. Fascia dentata. *e*. Cavity of lateral ventricle.

formed, is of a triangular shape: the middle part of it is covered by the fornix and constitutes the velum interpositum,

Fig. 173.*

whilst the remainder projects at each side of the fornix into the lateral ventricles, and forms by its free borders the right and left choroid plexuses.

Choroid plexuses

The *choroid plexuses*, fig. 171, &c., *e e*, appear like two red knotted fringes, reaching from the foramen of Monro to the point of each descending cornu. They are represented

* A section of the cerebral hemisphere, showing both lateral ventricles, after the fornix has been divided and turned back, to expose the velum interpositum. *c*. The anterior portion of corpus callosum, cut across. *e*. The lyra, or under surface of back of corpus callosum. *f*. Anterior pillars of fornix cut across. N.B. These are represented of too great size. *g*. Anterior, *h*, posterior cornu of lateral ventricle. *k k*. Corpora striata. *q*. Pes hippocampi. *r r*. Thalami optici. *s s*. Tænia semicircularis. *t t*. Choroid plexuses. *v*. Velum interpositum. *x x*. Posterior pillars of fornix. *y*. Eminentia collateralis.

as being covered by a reflection of the lining membrane of the ventricle, which in this way is considered to keep the choroid plexuses outside the serous cavity of the ventricle, just as the intestines are excluded from the cavity of the peritoneum; but in admitting this view, it must be remembered that the epithelium changes its character where it covers the plexuses.

At the foramen of Monro, where the middle and lateral ventricles communicate, their lining membrane is continuous, and here the two choroid plexuses are connected with one another. are joined together at foramen of Monro.

On raising the velum interpositum, two slight vascular fringes are seen running along its under surface, and diverging from each other behind. They form the *choroid plexuses* of the third ventricle. Choroid plexuses of third ventricle.

The choroid plexuses consist of a highly vascular villous membrane. The villi with which they are covered are again divided upon their surfaces and at their borders into smaller processes, along which fine vessels are seen to run. They are covered by a single layer of thick epithelium composed of large roundish corpuscles, in each of which is seen, besides a distinct nucleus, several yellowish granules, and one or more dark, round oil-drops. According to Henle each of these cells is provided with short, slender, acuminate, transparent, and colourless processes, like spines. The arteries of the velum interpositum and choroid plexuses enter from behind beneath the corpus callosum, and also at the point of the descending cornu; after ramifying in the plexuses, they send branches beneath the ventricular lining membrane to enter the substance of the brain. Veins issuing from the cerebral substance are seen on the surface of the ventricles, and for the most part join the veins of the choroid plexuses. The greater number of these terminate in two principal vessels named the veins of Galen, which run backwards on the velum interpositum, and passing out beneath the corpus callosum pour their blood into the straight sinus, having generally first united into a single trunk. Structure; covered with a peculiar epithelium; their arteries, and veins.

The velum having next been removed, the optic thalami are brought fully into view, and the cavity of the third ventricle, situated between them. In front and to the outer side of the thalami, as already stated, are the *corpora striata*. These last are two large ovoid masses of grey matter, fig. 171, &c., *k k*, the greater part of which is embedded in the middle of the white substance of the Corpora striata; partly

bedded in hemisphere; partly seen in ventricles.

hemisphere of the brain, whilst a part projects into the fore part of the body and the anterior cornu of the lateral ventricle. This *intraventricular* portion of the corpus striatum, *k k*, fig. 173, 174, is of a pyriform shape, its larger end being turned forwards, and its narrow end being directed outwards and backwards, so that the optic thalami of the two sides are received between the diverging corpora striata.

Surface is grey.

The surface of the corpus striatum is composed of grey matter; it is covered by the lining membrane of the ventricle, and is crossed by veins of considerable size. At some depth from the surface white fibres may be seen on cutting into it, which are prolonged from the corresponding cerebral peduncle and give it the streaked appearance from which it has received its name.

The *extraventricular* portion of the corpora striata will be afterwards described.

Tænia semicircularis.

Along the inner border of each corpus striatum, and in a depression between it and the optic thalamus, is seen a narrow whitish semitransparent band, named *tænia semicircularis*, fig. 171, &c., *s s*, which continues backwards into the descending cornu of the ventricle, where its connections cannot be assigned with precision. In front it reaches the corresponding anterior pillar of the fornix, and descends in connection with that cord of white substance. It is more transparent and firm on the surface, especially at its fore

tria cornea.

part: and this superficial stratum has been named *stria cornea.* The tænia consists of longitudinal white fibres, the deepest of which running between the corpus striatum and the thalamus, were named by Vieussens *centrum geminum semicirculare.* Beneath it are one or two large veins, which receive those upon the surface of the corpus striatum and end in the veins of the choroid plexuses.

Thalami optici;

The *thalami optici*, figs. 171 and 174, *l l* (posterior ganglia of the brain), are of an oval shape, and rest on the corresponding cerebral crura, which they in a manner embrace. On the outer side each thalamus is bounded by the corpus striatum and tænia semicircularis, and is then continuous with the medullary substance of the hemisphere. Its upper

in part are free and seen in ventricles.

surface is free and prominent and is partly seen in the lateral ventricle, and partly covered by the fornix. The posterior surface, which is also free, projects into the descending cornu of the lateral ventricle. The inner sides of the two thalami are turned towards each other, and form the lateral boundaries of the third ventricle, across which,

however, they are connected by a grey mass of nervous substance, named the soft commissure. Near the fore part of each thalamus is a small elevation on its upper surface, named its *anterior tubercle*, fig. 174*. The optic thalami are white on the surface, and consist of several layers of white fibres intermixed with grey matter. Anterior tubercles of optic thalami.

The third ventricle, fig. 174, *z* to *s*, is a narrow longitudinal fissure or cleft placed between the optic thalami, which bound it on its two sides. It is covered above by the velum interpositum and the fornix. Beneath, its floor is formed by the following parts, which have been already described, as seen on the base of the cerebrum, viz., commencing from behind, the posterior perforated space, the corpora albicantia, the tuber cinereum and infundibulum, and the lamina cinerea, which also serves to close it in front, as high as the anterior commissure. Passing across the cavity of the third ventricle are seen three commissures, named from their position, anterior, middle, and posterior. The third ventricle; its boundaries; its roof; floor; parts forming it; its commissures.

The *middle* or *soft commissure*, *b*, (com. mollis,) is composed almost entirely of grey matter, and connects the two thalami. It is variable in size, and sometimes, though very rarely, wanting; but it is frequently torn across in examining the brain. Middle or soft commissure;

The *anterior* commissure, in front of *z*, is a round bundle of white fibres, placed immediately in front of the anterior pillars of the fornix, and crosses between the corpora striata. It marks the anterior boundary of the ventricle; its fibres extend laterally through the corpora striata, a long distance into the substance of the cerebral hemispheres.

The *posterior commissure*, *s*, also white, is placed across the back part of the ventricle, immediately before and below the pineal gland. It is smaller than the anterior commissure, and has the form of a flattened band. It passes into the thalami on each side, but does not extend so far into the substance of the brain as the anterior commissure. and posterior.

The following apertures lead from or into the third ventricle: Apertures of third ventricle.

Above and before is the foramen of Monro, by which the third communicates with the two lateral ventricles.

Behind, is an opening leading into the *iter a tertio ad quartum ventriculum*, or *aqueduct of Sylvius*, fig. 170, *d*, *v*, which passing down below the posterior commissure, and the corpora quadrigemina, conducts into the fourth ventricle. Aqueduct of Sylvius.

In the floor of the third ventricle is . leep pit, corre- Iter ad in-

fundibulum; not an outlet.

sponding with the infundibulum, and generally named *iter ad infundibulum*, but there is no outlet at this part.

Fig. 174.*

Foramen of Monro.

The lining membrane of the lateral ventricles is continued down through the foramen of Monro, and lines the third ventricle, whence it extends along the Sylvian aqueduct into the fourth ventricle. Bichat conceived that this

* Section of the cerebrum, displaying the surfaces of the corpora striata, and optic thalami, the cavity of the third ventricle, and the upper surface of the cerebellum.—*a e*. Corpora quadrigemina,—*e* testes, *a* nates. *b*. Soft commissure. *c*. Corpus callosum. *f*. Anterior pillars of fornix. *g*. Anterior cornu of lateral ventricle. *k k*. Corpora striata. *l l*. Optic thalami. * Anterior tubercle of the left thalamus. *z* to *s*. Third ventricle. In front of *z*, anterior commissure. *b*. Soft commissure. *r*. Tænia semicircularis. *s*. Posterior commissure. *t*. Reflected portion of corpus callosum. *p*. Pineal gland with its peduncles. *n n*. Processus a cerebello ad testes. *m m*. Hemispheres of the cerebellum. *h*. Superior vermiform process. *i*. Notch behind cerebellum.

membrane was continuous with the arachnoid membrane on the exterior of the brain, and he therefore named it the internal arachnoid. He supposed that the external arachnoid membrane entered the third ventricle in the form of a tubular process, which passed beneath the posterior end of the corpus callosum and fornix, above the pineal gland and through the velum interpositum, and thus opened into the upper and back part of the third ventricle. The existence of this canal, named the *canal of Bichat*, is doubtful. It is certainly not constant.

Lining membrane of ventricle.

So-called canal of Bichat.

Pineal gland and *corpora quadrigemina.* Behind the third ventricle, and in front of the cerebellum, are certain eminences, which may be reached from the surface of the brain. These are the corpora quadrigemina, and above them is the pineal gland.

Pineal gland;

The *pineal gland*, fig. 170, *u*, fig. 174, *p*, (conarium,) so named from its shape (pinus, conus, the fruit of the fir,) is a small reddish body, which is placed beneath the back part of the corpus callosum, and rests upon the anterior pair of the corpora quadrigemina. Huschke states that it is larger in the child and female than in the adult or male. It is attached to the under surface of the velum interpositum, so that it is liable to be torn away from the brain in removing that membrane. It is about three lines in length, and its broad part or base is turned forwards, and is connected with the rest of the cerebrum by white substance. This white substance is principally collected into two small rounded bundles, named *peduncles* of the pineal gland, which pass forwards upon the optic thalami, to which they are attached along the upper limit of the third ventricle, and may be traced in that direction as far as the anterior pillars of the fornix, in conjunction with which they descend, fig. 174. These peduncles are connected with each other behind. The base of the pineal gland is also connected by a transverse lamella of white substance with the back of the posterior commissure. Some anatomists have described two *inferior peduncles*, which descend upon the inner surface of the thalami.

its peduncles;

Inferior peduncles.

Structure: is hollow; contains fluid and gritty matter, acervulus cerebri.

The pineal gland is very vascular. It is hollowed out into two or more cells, which, sometimes at least, open anteriorly into the ventricle, and almost always contain, besides a viscid fluid, a quantity of gritty matter, named *acervulus cerebri*. This consists of microscopic round particles, aggregated into small compound masses, which are

again collected into larger groups. It is composed of the so-called amylaceous, or amyloid bodies, and of earthy salts combined with animal matter; viz. phosphate and carbonate of lime, with a little phosphate of magnesia and ammonia (Stromeyer). It is found at all ages, frequently in young children, and sometimes even in the fœtus. It cannot, therefore, be regarded as the product of disease. This sabulous matter is frequently found on the outside of the pineal body, or even deposited upon its peduncles.

Corpora quadrigemina, are two pairs.

The *corpora* or *tubercula quadrigemina* are four rounded eminences, fig. 174, *a e*, separated by a crucial depression, placed two on each side of the middle line, one before another. They are connected with the back of the optic thalami, and with the cerebral peduncles at either side; and they are placed above the passage leading from the third to the fourth ventricle.

Anterior pair larger and darker.

The upper or anterior tubercles, fig. 174, *a a*, are somewhat larger and darker in colour than the posterior, *e e*. In the adult, both pairs are solid and are composed of white substance outside, containing grey matter within.

Connections with cerebellum below.

They receive bands of white fibres from below, the chief of which are derived from a fasciculus named the fillet. A white cord also passes up on each side from the cerebellum to the corpora quadrigemina, and is continued onwards to the thalami: these two white cords are the *processus a cerebello ad testes*, or superior peduncles of the cerebellum, fig. 168, *f*, fig. 174, *n n*. At each side the corpora quadrigemina send off two white tracts, which pass to the thalami and to the commencements of the optic nerves. These tracts are prominent on the surface, and are sometimes named *brachia*.

Connections at sides.

Brachia.

In man are small. Form in animals.

In the human brain these quadrigeminal bodies are small in comparison with their size in the series of animals. In ruminant, soliped, and rodent animals, the anterior tubercles are much larger than the posterior, as may be seen in the sheep, horse, and rabbit; and hence have been applied the names *nates* to the anterior and *testes* to the posterior tubercles. In the brains of carnivora, the posterior tubercles are rather the larger.

In fœtus, appear early; are hollow, and single on each side.

In the fœtus this part of the brain appears very early, and then forms a large proportion of the cerebral mass. The eminences are at first single on each side and hollow. They are constant in the brains of all vertebrate animals, but in fishes, reptiles, and birds, they are only two in number,

and hollow: in marsupialia and monotremata, they are also two in number, but are solid. Corpora geniculata.

To the outer side of the corpora quadrigemina and on the under and back part of each optic thalamus, are found two small oblong and flattened eminences, connected with the posterior extremity of the optic tract. These optic tracts, which we have already seen on the base of the cerebrum, attached to and embracing the under side of the corresponding peduncles, may be traced back to the thalami. Each tract becomes flattened and broader as it approaches the thalamus, and makes a bend as it turns round the peduncle to reach the back part of that body. Near this bend, which is named the *knee* (genu), are placed the two small eminences just spoken of. They are two little masses of grey matter about the size and shape of coffee beans, placed one on the outer and one on the inner side of the genu of the optic tract, and hence are named respectively *corpus geniculatum, externum, internum.* They send fibres into the optic tract and also into the thalamus of the same side. Course of optic tract: its genu; has two small eminences near it, corpora geniculata.

The fibres of these tracts are therefore derived from three sources, viz., the thalamus, the tubercula quadrigemina, and the corpora geniculata. Origin of optic tracts.

Extending downwards and somewhat outwards from the corpora quadrigemina to the fore part of the cerebellum, and connecting the latter with the cerebrum, are two large white cords, the *processus a cerebello ad testes*, fig. 174, *n n*, already alluded to. Between them is stretched a thin semitransparent layer of nervous matter, which lies over the passage from the third to the fourth ventricle, and, lower down, covers in a part of the fourth ventricle itself. This is the *valve* of Vieussens, between *n n* (velum medullare anterius). It is narrow above, where it is connected with the quadrigeminal bodies, and broader below, where it is continuous with the median portion of the cerebellum. From its attachment at the sides to the processus ad testes, these latter have been described as the *pillars* of the valve. Processus a cerebello ad testes. Valve of Vieussens. Its attachments; pillars; and structure.

The upper portion of the valve is composed of medullary substance, but a few transverse ridges of grey matter extend upon its lower half, as if they were prolonged from the grey lamellæ of the cerebellum with which it is there continuous. From between the posterior quadrigeminal tubercles a slight median ridge, named *frænulum*, descends a little way upon The frænulum of the valve.

the velum; and on each side of this the commencing transverse fibres of the fourth pair or pathetic nerves may be seen.

The valve of Vieussens is overlapped and concealed by the adjacent folia of the cerebellum, which must be drawn back in order to bring it into view.

THE CEREBELLUM.

The cerebellum, consists of body and peduncles.

The *cerebellum*, *little brain*, or *after brain* consists of a *body* and three pairs of *crura* or *peduncles*, by which it is connected with the rest of the encephalon. They are named superior, middle, and inferior peduncles, and have all been incidentally mentioned.

Superior peduncles;

The *superior peduncles* connect the cerebellum with the cerebrum (crura ad cerebrum). They are the parts already described under the name of the processus ad testes.

inferior;

The *inferior peduncles* (processus a cerebello ad medullam; crura ad medullam) pass downwards to the back part of the medulla oblongata, and correspond with the restiform bodies.

and middle;

The *middle peduncles* (crura ad pontem) pass from the middle of the cerebellum around the outer side of the crura of the cerebrum, and meet in front in the pons Varolii, constituting its transverse fibres. They connect the two halves of the cerebellum together below.

are composed of white fibres.

All these peduncles consist of white fibres only; and they pass into the interior of the cerebellum at its fore part. Their connections with that organ will be afterwards described.

Body of cerebellum; colour; dimensions.

The *body* of the cerebellum being covered with cortical substance is of a grey colour externally, but is rather darker on the surface than the cerebrum. Its greatest diameter is transverse; it is about three and a half or four inches wide, about two or two and a half from before backwards, and about two inches deep in the thickest part, but is much thinner all round its outer border.

Consists of two hemispheres and a median portion.

It consists of two lateral *hemispheres* joined together by a median portion called the *worm*, or vermiform process, which in birds, and in some animals still lower in the scale, is the only part existing.

Hemispheres separated behind by notch;

The hemispheres are separated behind by a deep *notch*, figs. 174, 175, *i*, so that the outline of the two, as seen from above, resembles a very wide-shaped heart as drawn on

playing cards, the notch being directed backwards. On the upper surface, the median portion or superior vermiform process, fig. 174, *h*, though slightly elevated, is scarcely marked off from the hemispheres, so that the general surface of the organ, which is here inclined on either side, is uninterrupted. Below, the hemispheres are convex and are separated by a deep fossa, named the *valley*, fig. 175, *i* to *s* **below by vesicula.**

Fig. 175.*

(vallecula), which is continuous with the notch behind. Into this hollow the medulla oblongata, *m*, is received in front, and the falx cerebelli behind. The under surface of the median portion of the cerebellum appears in this depression, and is sometimes named the inferior vermiform process.

The folia of cerebellum. The body of the cerebellum at the surface and for some depth consists of numerous nearly parallel laminæ or folia, which are composed of grey and white matter, and might be compared with the gyri of the cerebrum, but are smaller

* An under view of the cerebellum, seen from behind,—the medulla oblongata, *m*, having been cut off a short way below the pons. (Reil.) *c*. Pons Varolii. *d*. Middle crus of cerebellum. *e e*. Crura cerebri. *i*. Notch on posterior border. *k*. Commencement of horizontal fissure. *l*. Flocculus or subpeduncular lobe. *m*. Medulla oblongata cut through. *q* to *s*. The inferior vermiform process, lying in the vallecula. *p*. Pyramid. *r*. Uvula. *n n*. Amygdalæ. *s*. Nodule or laminated tubercle. *x*. Posterior velum, partly seen. *w*. Right and left hemispheres of cerebellum. 3 to 7. Nerves. 3 3. Motores oculorum. 5. Trigeminal. 6. Abducent nerve. 7. Facial and auditory nerves.

and not convoluted. These are separated by sulci of different depths.

Horizontal fissure. One principal fissure or sulcus, named the *great horizontal fissure*, divides the cerebellum into an upper and a lower portion. It begins in front at the entrance of the middle crura, and passes horizontally backwards around the outer border of the hemispheres. Other smaller fissures. From this primary fissure numerous others proceed on both the upper and under surface, forming parallel curves, having their concavities turned forwards and separating the folia from each other. All these furrows do not go entirely round the hemisphere, for they often coalesce with one another; and some of the smaller furrows have even an oblique course between the others. Moreover, on opening the larger fissures many of the folia are seen to lie concealed within them, and do not reach the surface of the cerebellum.

Lobes of cerebellum, Certain fissures, which are deeper than the rest and constant in their position, have been described as separating the cerebellum into lobes, which are thus named :—

on upper surface; The *central lobe*, fig. 174, *v*, situated on the upper surface, consists of about eight folia, immediately adjoining the anterior concave border. The *superior and anterior* lobe, *m*, and the *superior and posterior* lobe, *u*, are placed between the central lobe and the great horizontal fissure. On the on under surface. under surface, fig. 175, *w*, are seen successively the *inferior posterior* lobe, the *slender* lobe, the *biventral* lobe, the *amygdalæ*, *n n*, and the *subpeduncular lobe* or *flocculus*. Flocculus or subpeduncular lobe. This last-named lobule, *l l*, *lobule of the pneumo-gastric nerve* (Vicq-d'Azyr), *subpeduncular lobe* (Gordon), or *flocculus*, projects behind and below the middle peduncle of the cerebellum. It is connected by a slender pedicle of white fibres to the rest of the hemisphere ; but its exposed surface is grey, and is subdivided into a few small laminæ.

Lobes in or near vallecula. Within the vallecula, or on its borders, the following parts are seen.

Commencing from behind, a conical and laminated projection, named the *pyramid*, is first met with, *p*. Pyramid. In front of that is another smaller projection, called the *uvula*, *r*, Uvula. which is placed between the two rounded lobes at the sides of the vallecula, named the *amygdalæ*, *n n:* Amygdalæ. these terms being suggested by a comparison with the parts so named in the throat. Between the uvula and amygdalæ on each side, but concealed from view, is extended a ridge of grey The furrowed band. matter indented on the surface, and named the *furrowed*

band. Still further forward is the anterior pointed termination of the inferior vermiform process, named the *nodule*, *s*, which projects into the fourth ventricle, and has been named the *laminated tubercle* (Malacarne). On each side of the nodule is a thin white lamella of a semilunar form, which is attached by its posterior convex border, and is free and concave in front. The outer ends of these lamellæ are attached to the flocculi, and the inner ends to the nodule, and to each other in front of that projection. The two lamellæ together constitute the *posterior medullary velum*, *x*, (velum medul. post.), which has been compared with the valve of Vieussens,—the one being attached to the superior extremity and the other to the inferior extremity of the middle or vermiform portion of the cerebellum. This posterior velum is covered in and concealed by the amygdalæ, and cannot be properly seen until those lobules have been turned aside. Nodule. Posterior velum.

The Fourth Ventricle.—The space left between the medulla oblongata in front and the cerebellum behind, is named the fourth ventricle, or *ventricle of the cerebellum*, fig. 170, *v*. The fourth ventricle.

The cavity of this ventricle is contracted above and below, and is widest across its middle part. The anterior extremity of the inferior vermiform process projects into it from behind, and higher up it is covered by the Vieussenian valve. It is bounded laterally by the superior peduncles, and lower down it is shut in at the sides by the reflection of its lining membrane from the medulla to the cerebellum. The upper end of the ventricle is continuous with the Sylvian aqueduct or passage (iter) leading up to the third ventricle. Its cavity and boundaries.

The anterior boundary or *floor* of the fourth ventricle, fig. 168, *v* 7 *v'* 7, is formed by the back of the medulla oblongata and pons Varolii. It is shaped like a lozenge, truncated at its upper part. Below, it is bounded by the diverging posterior pyramids and restiform bodies surmounted along their margin by a band of nervous substance called the *ligula*. In the middle of the floor is seen the longitudinal median fissure, *v v'*, which is gradually obliterated towards the upper part of the ventricle, and forms at its lower end, where it meets the converging borders of the posterior pyramids, the point of the *calamus scriptorius*, *v'*. Near this is the small orifice already described as leading into the upper part of the canal in the spinal cord. Its floor lozenge-shaped. Parts seen in it. Calamus scriptorius.

Fasciculi teretes.

Along the sides of the median fissure, in the upper part of the ventricle, are placed two rounded longitudinal eminences, greyish below, but appearing white higher up, fig. 168. These are the *fasciculi teretes*, fig. 181, *a*, (faisceaux innominés,—Cruveilhier,) which pass up from the medulla along the back of the pons and enter the cerebrum.

Grey matter on floor, arranged into eminences.

Towards the lower part of the ventricle, the central grey matter of the medulla is opened out on the surface, being covered only by a thin translucent layer, and forms several small angular elevations, fig. 168 *e*, *c*, *i*, *v'*, which, as we shall hereafter see, have been recently shown to be connected with the origin of the eighth, ninth, and probably the fifth pairs of nerves. The grey matter in the floor of the fourth ventricle has been named *fasciolæ cinereæ*. Upon it, several transverse white lines or striæ are usually observed, passing across from the median fissure, around the sides of the restiform bodies. Some of these white striæ form part of the roots of the auditory nerves, [7 7], a few run slantingly upwards and outwards on the floor of the ventricle, whilst others again embrace the corresponding half of the medulla oblongata. These transverse lines are sometimes wanting, in which case the white fibres on which they depend probably exist at some depth beneath the surface.

Forms fasciolæ cinereæ.

Is crossed by white striæ.

The lining membrane; communications with third ventricle,

The *lining membrane* of the ventricle is continuous with that of the other ventricles through the aqueduct of Sylvius, in which situation it is marked by delicate rugæ, oblique or longitudinal in direction. At the sides it is reflected from the medulla to the cerebellum, as already stated, and extends for a considerable distance outwards between the flocculus and the seventh and eighth nerves. At the lower end of the ventricle, this cavity communicates with the subarachnoid space. This communication, as stated by Magendie, may be generally shown independently of laceration. Bichat described the lower end of the fourth ventricle as being closed by the lining membrane, a condition which may perhaps sometimes exist.

with subarachnoid space.

Has small choroid plexuses.

Projecting into the fourth ventricle at each side, and passing from the point of the inferior vermiform process outwards and upwards to the outer border of the restiform bodies, are two small vascular processes, which have been named the *choroid plexuses* of the fourth ventricle.

Cerebellum: grey outside

Section of the cerebellum.—Sections of this part, in any

or in all directions, show that the surface of the hemispheres and vermis, even at the bottom of the smallest furrows, is composed of a continuous layer of grey matter; and that the white medullary substance is communicated in the centre, but sends off numerous thin and flat processes, which pass into the middle of each grey lamina. Owing to this arrangement, sections of the cerebellum present a beautifully foliated or arborescent appearance, which however is most perfectly seen on a vertical section made in the median plane, where the relative quantity of the central white matter is small. The appearance in question has been named *arbor vitæ*, fig. 170, *l*.

and white within.

Arbor vitæ.

In the lateral hemispheres, where the peduncles enter, the white matter is more abundant; and if a section be made through either hemisphere half way between its centre and the middle of the vermiform process, it will display a nucleus of grey matter, which is named the *corpus dentatum* of the cerebellum, fig. 176, *b*. This presents the appearance of a waved line of yellowish brown matter, surrounded by white substance and containing whitish matter within. This line is interrupted at its upper and inner part. In whatever direction the section is carried through the corpus dentatum, this waved line is seen, so that the dentate body may be described as consisting of a plicated pouch or capsule of grey substance open at one part and inclosing white matter in its interior, like the corpus dentatum of the olivary body. White fibres may be traced out from it to the superior peduncles of the cerebellum and to the valve of Vieussens.

Corpus dentatum of cerebellum

is an open sac of grey matter.

INTERNAL STRUCTURE OF THE CEREBRO-SPINAL AXIS.

The brain and spinal cord consist of *grey* and *white* nervous matter: the former being also called the *cineritious*, or where it lies upon the surface the *cortical* substance, and the latter being also named *medullary*. The microscopic structure of these two components of the nervous centres is given in the part devoted to the general anatomy.

Of the white or medullary substance, it may here be stated that it consists of microscopic fibres arranged into laminæ and bundles, between which intervening vessels ramify. The existence, course, and arrangement of these fibrous plates and bundles, which are rendered much more evident by hardening the brain in alcohol, are found to be

White substance of brain and cord, fibrous and laminated.

constant in all cases; but our knowledge of their apparently complicated connections with each other and with the grey matter, is at present imperfect and fragmentary; for which reason, the subject can only be briefly treated of consistently with the limits and purposes of the present work. For more detailed information the reader is referred to the special treatises enumerated below.*

INTERNAL STRUCTURE OF THE SPINAL CORD.

Spinal cord; The general arrangement of the white and grey substances in the spinal cord may be here briefly recapitulated.

its white columns. The *white matter* in each half of the cord is divided by the fissures or by the grey matter within into three columns, figs. 164, an anterior *a e c*, lateral *c e b*, and posterior *b e p*. The anterior and lateral columns are continuous with each other at the surface, there being no antero-lateral fissure, and form in fact but a single column—the antero-lateral column *a e b*. The posterior columns include also the two small tracts placed one on each side of the posterior median fissure, sometimes named the slender fasciculi (see p. 439).

Structure and arrangement of white fibres. The white substance of the cord consists of tubular fibres, of smaller average size than those of the nerves, and apparently of more delicate structure, for they readily become varicose. They are collected into bundles and laminæ, between which lie vessels and a few fibres of areolar tissue, and hence the fibrous and lamellar character visible in the white substance to the naked eye. The general direction of the fibres is longitudinal; but some are described as passing obliquely across from one half of the cord to the other. Of the longitudinal fibres some are continued into the roots of the spinal nerves; but this does not appear to be the case with all.

* Vicq-d'Azyr—Traité de l'Anat. et Physiol., 1786; Reil—Various Memoirs in his Archiv. für. die Physiologie; Rolando—Sopra la vera struttura del Cervello, 1828; Mayo—Engravings of Structure of Brain and Spinal Cord, 1827; Solly—The Human Brain, &c., 1836; Cruveilhier—Anatomie Descriptive, 1835; Arnold—Bemerkungen über den Bau des Hirns, &c., 1838—and Icones Anatomicæ, Fasc. I.; Foville—Traité de l'Anat., &c. du Système Nerveux Cerebro-Spinal, avec planches, 1844; Förg—Vom innern Baue des Gehirns, 1844; Kölliker—Mikroskop. Anatomie; J. L. Clarke—Phil. Trans., 1851 and 1853.

Grey part of the spinal cord.—The grey part of the cord represents in a transverse section two lateral crescent-shaped masses, turned back to back, with their cornua averted, and their convexities connected across the median plane by a grey commissure, in the centre of which is the canal already described. The small posterior cornu or horn of each crescent reaches the surface of the posterior lateral fissure. The anterior horn is larger, and does not quite reach the surface of the cord. In its intimate structure the grey matter differs in different situations; that of the posterior cornu, from its semi-transparent appearance, was named the *substantia gelatinosa* by Rolando; the remaining and greater part of the grey matter, which resembles that most generally prevalent, was named by Rolando the *substantia spongiosa*. Besides these two varieties, Mr. Clarke has described a deposit of vesicular matter in close relation to the posterior cornua. Each of these requires special description.

Grey matter, general arrangement.

Gelatinous and spongy parts where found.

The *gelatinous* substance of the posterior horn consists almost entirely of the smaller nerve-cells, and numerous tubular nerve-fibres of small size, but with these there are intermixed a few of the larger ganglionic corpuscles. The smaller cells are nucleated, and have fine ramifying processes. The fibres are derived in great part at least from the posterior roots of the nerves.

Structure of gelatinous: cells, and fibres.

The *spongy* substance of the anterior horn, and grey substance generally, with the exception of the subst. gelatinosa, consists of two kinds of cells, and of tubular fibres. First, there are very large branched cells, from $\frac{1}{400}$ to $\frac{1}{200}$ inch in size, containing simple nuclei and pigment. These are chiefly found in the anterior cornu, where they are arranged in an outer and inner group; but they are also scattered throughout the whole of the subst. spongiosa. Besides these there are smaller cells, ranging from $\frac{1}{3000}$ to $\frac{1}{400}$ inch, but the majority are from $\frac{1}{1200}$ to $\frac{1}{600}$ inch in size. These are not collected into groups, but occur throughout the whole of the spongy substance. They contain single nuclei, and are furnished with processes, the latter being less marked than those of the larger cells. Then there are numerous tubular fibres, constituting one half of the grey matter. These are not more than one half the diameter of their continuations in the white substance, and in the nerve-roots, but among these fibres there are a few of larger size.

Structure of spongy substance. **Large cells.** **Small cells.** **Tubular fibres.**

Vesicular tract of Mr. Clarke.

The *vesicular* column, described by Mr. J. Lockhart Clarke, exists as a tract of grey matter, containing cells, on either side of the posterior cornua. It is in intimate connection with the posterior roots of the nerves; it may be traced continuously from the lower extremity of the spinal cord to the medulla oblongata, where it terminates; and it increases in size in both the lumbar and cervical enlargements.

Superficial origin of spinal nerves.

Origin of the spinal nerves.—The anterior and posterior roots of the spinal nerves are attached along the sides of the cord opposite to the corresponding cornua of the grey matter, fig. 164. The posterior roots, *s*, in a straight line, and the anterior roots, *r*, scattered somewhat irregularly upon the surface.

Deep origin generally considered.

As to the deep connections of these roots it is now ascertained that their fibres may be traced into the grey matter. Valentin, Kölliker, and Lockhart Clarke, all agree in this; but Valentin and Kölliker are of opinion that they all come out again from the grey substance, and ascend in the white columns of the cord; while Mr. Clarke believes that many come out again, but that some are lost to view in the grey substance and probably remain there; that some form loops, either in the grey substance or in the white columns; and that others cross from one side of the cord to the other. This decussation takes place, according to Kölliker, in the anterior white commissure, the fibres crossing very obliquely in an upward course; but according to Mr. Clarke, the crossing fibres are confined to the grey matter.

Anterior roots in two divisions. Kölliker's view.

The *anterior roots* may be traced into and through the anterior cornua. They then, according to Kölliker, form two main divisions, following different directions. That which is most internal passes through the internal group of cells, and crosses in an obliquely ascending direction to the anterior column of the opposite side; the external bundle passes through the outer group of cells, and ascends in the fore part of the lateral column of the same side.

Clarke's.

According to Mr. Clarke, the anterior roots pass straight to the grey matter, and then diverge in all directions like the hairs of a brush. Some form loops with contiguous fibres, some run outwards to the lateral columns, some inwards to the opposite anterior columns, decussating at the bottom of the anterior fissure with those from the opposite side; and many pass longitudinally downwards as well as upwards.

The *posterior roots*, according to Kölliker, enter the posterior cornu, some of the fibres passing obliquely, and others horizontally, inwards. They then form two divisions, one ascending in the posterior column and the adjoining portion of the lateral column; the other entering the same columns, but chiefly the posterior, and also passing apparently through the posterior grey commissure to the posterior and lateral columns of the opposite side. **Posterior roots according to Kölliker.**

Mr. Clarke's account is different. He describes some fibres passing forwards to the grey matter, and then bending downwards longitudinally so as to form a tract of tubular substance from which fine bundles of fibres proceed into the anterior grey substance. Some of these fibres form loops with each other near the border of the grey matter; others extend into the anterior white columns, and are distributed both upwards and downwards; of these last some re-enter the grey substance and some are lost in the white columns while others probably join the anterior roots. **Clarke's account.**

Another set of fibres slant principally upwards, but some downwards, in the posterior columns, and, interlacing with each other, most probably enter the grey matter at different heights. Some are, however, lost to view in the posterior white columns, and it is uncertain whether they do not immediately ascend through these columns to the brain.

A third division runs straight into the grey matter, and its fibres, interlacing with those of the opposite side, decussate behind the central canal, and reach the posterior and lateral columns of the other side.

As to the intimate relation of the nerve-fibres to the cells of the grey matter, there are different views, to which reference is made in the "General Anatomy." **Relation of fibres to cells.**

The course of the white fibres within the cord, and their ultimate destination has not yet been satisfactorily determined. Different methods have been employed in the investigation, and hitherto the results have differed. Volkmann arrived at the conclusion that all the nerve-fibres attached to the cord were specially and exclusively spinal: *i. e.* that they either originated or terminated in the cord itself, none of them being transmitted to the brain. Volkmann was led to this opinion by measurements of the cord in different regions, such measurements proving, in his judgment, that the cord could not contain in its upper regions all those nerve-fibres which were traceable to it in the lower. Kölliker, supposes that all the fibres ascend to **Course of fibres in the cord.** **Volkmann's opinion.** **Kölliker's.**

the cerebrum; and he pointed out that Volkmann had not made proper allowance for the diminished size of the fibres as they ascend in the cord. Others have endeavoured to trace the fibres from one portion of the cord to another, and by actual observation to determine their direction. It has already been shown that Kölliker and Mr. Lockhart Clarke agree in their belief that many of the fibres become longitudinal in the white columns. But Kölliker is of opinion that all those which become longitudinal have an ascending direction, and a termination in the brain: whereas Mr. Clarke thinks that this is the case only with regard to some. The belief of Mr. Clarke is based upon the fact that he has discovered fibres descending (as well as ascending) from the roots of the nerves; and further that appearances seem to warrant the conclusion, that of those which pursue an ascending course some re-enter the grey matter of the cord at different heights.

Clarke's.

From physiology.

The results of physiological experiment do not afford any satisfactory explanation of the direction of those anatomical elements which are recognised in the cord. The paths for the transmission of motor impulses and of sensory impressions may be traced with seeming accuracy, but the results obtained are not at present explicable upon anatomical grounds. Both classes of facts may for the time being be received as such, although they cannot as yet be rationally connected with each other. In this work it would be out of place to enter upon a statement of these physiological conclusions; but it may be mentioned that the more recent researches of M. Brown-Séquard lead him to these two important inferences; viz.; that the paths of sensory impressions decussate in the cord itself, and those of motor impulses decussate above the cord.

Brown-Séquard.

INTERNAL STRUCTURE OF THE MEDULLA OBLONGATA.

White and grey matter increased. Arrangement of columns of cord.

The white and grey constituents of the spinal cord, when they have reached the medulla oblongata, become increased in size, and are altered in their arrangement, in the manner now to be described. The three white columns of the cord are disposed as follows.

Posterior columns go to cerebellum.

1. The *posterior column*, figs. 180, 181, *e*, consisting of the fasciculus cuneatus and the slender fasciculus which higher up is named posterior pyramid, forms the restiform body. This being joined by some fibres from the lateral

column, and, as indicated by Solly, by a few from the anterior column, enters the cerebellum as its inferior peduncle, fig. 176, *n*,—the part called the posterior pyramid, *p*, fig. 181, excepted, which, according to careful inquirers * passes up with the fasciculi teretes to the cerebrum.

excepting posterior pyramid.

Lateral column; goes part to cerebellum,

2. The *lateral column* ascends towards the base of the olivary body, and is disposed of in three ways; some of its fibres from the surface and deep part join the restiform body and go to the cerebellum; a larger number, fig. 179, *x*, come forwards between the anterior columns, and crossing the median plane, form the chief part of the opposite anterior pyramid, *b*; the remaining fibres pass up to the cerebrum, as the fasciculi teretes, (fig. 176, behind *c'*; faisceaux innominés,) appearing on the back of the pons Varolii, in the upper part of the floor of the fourth ventricle, fig. 181, *a*.

part to cerebrum, through anterior pyramids, or fasciculi teretes.

Anterior columns,

3. The *anterior columns* having reached the apex of the anterior pyramids, are thrust aside from their median position by the decussating fibres derived from the lateral columns, and are then distributed in three divisions. One, very small, ascends obliquely backwards beneath the olive, and joins the restiform body (Solly). Another division passes directly up, its fibres embracing the olivary nucleus, fig. 176, *c*, above which they are again collected together, and joined by other fibres arising from the corpus dentatum, so as to form the olivary fasciculus, *c'*; this ascends through the pons and at the side of the cerebral peduncle under the name of the fillet, fig. 180, *c*, *i*, *h*, and reaches the corpora quadrigemina by *i*, and the cerebral hemispheres by *h*. The remaining division of the anterior column ascends into the anterior pyramid, *a*, fig. 176, forming its outer part. The anterior pyramids therefore are composed of fibres from the lateral and anterior columns, and are continued up through the pons into the peduncles of the cerebrum.

a small part to cerebellum,

remainder to cerebrum;

through fillet,

or anterior pyramids.

Limits of columns of medulla not well defined

It is to be remembered, however, that the separation between these different tracts of white fibres cannot be clearly followed out through the whole structure of the medulla oblongata; for, at a certain depth from the surface, they are found to be more or less blended with one another.

* Burdach—Bau und Leben des Gehirns, 1819; Arnold,—Foville,—Förg—Operibus citatis.

Grey matter of medulla appears at side as grey tubercule, and is blended with white;

Grey matter of the medulla oblongata.—In ascending into the medulla oblongata, the grey matter becomes more abundant, and gets blended with all the white fasciculi, excepting the anterior pyramids, fig. 177, *b b*, which are composed entirely of white substance. The posterior horns

Fig. 176.*

increase in size, and are directed more to the side, where they appear at the surface in the form of a narrow grey stripe, which was called by Rolando *tuberculo cinereo*, *d*. A distinct mass of grey substance, forming the *corpus dentatum*, *c c*, exists within the olivary body.

forms corpus dentatum, or

* General view of the connection of columns of medulla oblongata with cerebellum and cerebrum (Mayo). A. Anterior lobe. B. Posterior lobe of cerebrum. C. Cerebellum. *a*. Anterior pyramid. *a′*. Continuation of same in pons. *c*. Olivary body. *c′*. Olivary fasciculus. Behind *c′*. Fasciculi teretes. *d*. White laminæ of cerebellum. *f*. Superior peduncles of cerebellum—processus ad testes. *g*. Anterior portion of peduncle—fibres of crust. *h*. Radiating peduncular fibres of cerebrum. *h y y*. Part of corona radiata. *h′*. Central fibres of convolutions. *i*. Fillet. *l*. Back of thalamus. *m*. Pons Varolii. *o*. Section of pes hippocampi. *r*. Tegmentum. *y y*. Indicates white fibres escaping from corpus striatum.

Huschke, however, states that it is continuous with the grey matter of the anterior horn, and also with that of the corpora quadrigemina, and optic thalami. The grey commissure of the cord, as it is continued upwards, becomes exposed at the back of the medulla, *p p*, in the floor of the fourth ventricle, owing to the divergence of the posterior white fasciculi; and it eventually disappears as a distinct median structure, being mixed with the white fibres of the fasciculi teretes.

Olivary nucleus; is exposed at back of medulla.

Fig. 177.*

A

B

Grey nuclei for 8th and 9th nerves.

According to the observations of Stilling, some part of the grey matter at the back of the medulla forms special deposits or nuclei, connected with the roots of the spinal accessory, vagus, glosso-pharyngeal and hypoglossal nerves.

Position of these in medulla;

Of these nuclei, the first or lowest is concealed in the substance of the medulla; whilst those which are situated higher up gradually appear as small triangular eminences in the floor of the fourth ventricle, near the point of the calamus scriptorius.—See fig. 168, in which *v'* shows the position of the nucleus for the spinal accessory, *i* that for the vagus, *e* that for the glosso-pharyngeal, and *c* that for the hypoglossal nerve. The *first nucleus* is that for the spinal accessory nerve. It reaches some way down in the cord, and then appears, on a transverse section, like a lateral process extending from the grey crescent between its anterior and posterior horns, and from it the slender and straggling roots of the nerve run outwards to the surface; as it extends upwards it approaches the middle and back part of the medulla oblongata, *v'*. In front of this nucleus, and close to the centre of the medulla, is another, the *second*, fig. 178, *h*, commencing higher up and connected with the hypoglossal nerve, the roots of which coming forward between the anterior pyramid and the olivary body, appear at the surface in the depression between those parts.

in floor of 4th ventricle.

1st, for spinal accessory.

2nd, for hypoglossal.

* Sections of the medulla oblongata—natural size—(Arnold). A. About middle of medulla. B. Higher up. *a*. Anterior fissure. *b*. Anterior pyramid. *c*. Olivary body and corpus dentatum. *d*. Grey tubercle. *p*. Posterior fissure in floor of fourth ventricle, where grey matter is accumulated.

Continuing to ascend, these two nuclei reach the back of the medulla, and then make their appearance in the floor of the fourth ventricle. Higher up, the nucleus for the spinal accessory nerve is succeeded by a *third* in the same

3rd, for vagus.

Fig. 178.*

line, *g*, which is connected with the nervus vagus, and is also placed to the outer side of that for the hypoglossus, *h*. Further out, a *fourth* nucleus, *f*, begins to be observed, belonging to the glosso-pharyngeal nerve. The last change in the arrangement of these small grey masses consists in the gradual narrowing of the nucleus of the par vagum, and the approximation of those for the hypoglossal and glosso-pharyngeal nerves, which were previously separated by it.

4th, for glosso-pharyngeal.

Langenbeck and Förg maintain that the part regarded by Stilling as the nucleus for the glosso-pharyngeal nerve is really the place of origin of the greater root of the fifth or trigeminal nerve.

Nucleus for 5th nerve.

The *horizontal white fibres* which form the antero-posterior septum, fig. 178, *i*, in the medulla oblongata, will be described along with a similar set of fibres existing in the pons.

* Section of the medulla oblongata, magnified two diameters, reduced from Stilling's plate. In this figure, which is viewed by transmitted light, Stilling regards the lighter parts as composed of grey matter. But on viewing a similar section by direct light, it appears to us that the roots of the nerves, the transverse curved lines, and the antero-posterior septum are really composed of white substance. *a*. Anterior, and *p*, posterior fissure. *b*. Pyramid. *c*. Olivary body, and its corpus dentatum. *d*. Grey tubercle in lateral fasciculus. *f*. Nucleus for glosso-pharyngeal nerve. *g*. Nucleus for vagus. *h*. That for hypoglossal nerve. *i*. The antero-posterior septum. 8. Roots of vagus nerve. 9. Roots of hypoglossal nerve.

INTERNAL STRUCTURE OF THE PONS VAROLII.

The pons Varolii consists of transverse white fibres, and of the longitudinal fibres prolonged through them from the medulla, intermixed with much grey matter. Fibres of pons and grey matter.

On dissecting it from the front, a superficial white layer, figs. 179, 180, *m*, also fig. 167, *p*, *i*, is met with, which Superficial layer, transverse;

Fig. 179.*

extends on either side into the middle crus of the cerebellum. Behind this are seen the prolonged fibres of the anterior pyramids, *b*, which, as they ascend through the pons, are widely separated into smaller bundles, intersected by other transverse white fibres, *m′*, which, like those upon the surface, are continued into the cerebellum. Amongst these two decussating sets of fibres is a large quantity of grey matter. next, longitudinal; then other transverse

The arrangement just described extends to a considerable depth in the pons, but is succeeded by a third layer, which consists entirely of longitudinal fibres. This comprehends the olivary fasciculus, fig. 180, *c*, *i*, *h*, and the fasciculi teretes, *t*, which, as we have frequently mentioned, run up lastly, other longitudinal.

* Fibres of medulla oblongata and pons, arranged in alternate layers—(Arnold). *b.* Anterior pyramid. *b′.* Prolongation of same through pons. *c.* Olivary bundle. *d.* Olive. *m.* Superficial transverse fibres of pons. *m′.* Deeper transverse fibres. *m″.* Prolonged as middle peduncle of cerebellum. *p*, *q*. Their continuation into laminæ or folia of same. *n.* Inferior peduncle. *x.* Decussating portion of left lateral column, crossing over to right anterior pyramid.

on each side and in the floor of the fourth ventricle, intermixed with much grey substance.

Septal fibres of medulla oblongata,

Septum of the medulla oblongata and pons.—Besides the white fibres already described, there exist in the medulla oblongata and pons others which extend from behind forwards, fig. 178, *i*, in the median plane. In the medulla, fig. 167, these appear above the decussation of the pyramids. Some issuing from the anterior fissure and turning round the sides of the medulla, form the arciform fibres, and those (sometimes named *fibræ transversæ*,) which occasionally cover the anterior pyramids and olivary bodies: others appearing at the surface, in the floor of the fourth ventricle, give rise to the transverse white striæ generally seen in that situation. These parts have been already described (p. 449, 486).

and of pons.

A median septum, of the same kind, obviously exists throughout the whole height of the pons, in its back part, but becomes indistinct in approaching the front or basilar surface, except towards its upper and lower edge, where the superficial fibres of the pons are manifestly continuous in the median line with these septal fibres; and bundles of white fibres, belonging to the same system, encircle the crura cerebri at their emergence from the upper border of the pons.

According to Foville, a few of the fibres from each of the three principal longitudinal elements of the medulla turn forwards and become continuous with the transverse fibres of the pons; and, in like manner, one or more small bundles from each of the crura cerebri take a similar transverse course.*

INTERNAL STRUCTURE OF THE CEREBELLUM.

Structure of cerebellum.

The cerebellum consists of an internal white medullary mass, containing on each side the corpus dentatum; of an external grey or cortical layer, covering the leaves or folia; and of three pairs of white peduncles.

Structure of folia.

Central white plates.

The *folia* consist of white matter covered externally with grey. The structure of each of them appears to be this:—from the central white mass of the cerebellum, thin plates, composed of white fibres, pass up in the centre of the folia, and divide into subordinate white laminæ, corresponding with the subdivisions of the folia. Many of these *central*

* Foville, op. cit., Pl. II. figs. 2 and 3. Pl. III. figs. 5 and 6.

white laminæ can be traced continuously from the peduncles of the cerebellum. Upon these central plates are laid other *collateral lamellæ*, which are not connected with the fibres proceeding from the middle of the cerebellum, but merely pass from one folium to another. Superficial to these white fibres is the grey cortical substance. **Collateral fibres.**

This *grey* matter is not uniform throughout its whole thickness, but is composed of two or more layers differing in colour and other characters;—resembling, in this respect, the cortical substance of the posterior convolutions of the cerebrum. **Grey matter consists of several layers.**

The *white* fibres, composing the peduncles of the cerebellum, are thus arranged in its interior. **Peduncles of cerebellum:**

The *middle* peduncles, fig. 179, *m*, which are the most superficial, pass from the pons Varolii, with the transverse fibres of which they are directly continuous, and enter the lateral parts, *m*, *p*, of the cerebellum. They may be traced into the folia of those parts, *q*, and form a large share of each hemisphere. **middle;**

Fig. 180.*

The middle peduncles being removed, the *inferior* peduncles (restiform bodies) come into view, figs. 176, 179, 180, *n*. **inferior;**

* Arrangement of columns of medulla; and of superior and inferior peduncles of cerebellum—(Arnold). *a*. Part of anterior column, which ascends to the olive. *b*. Decussating portion of lateral column. *c*. Olivary fasciculus. *d*. Olive. *e*. Restiform body. *f*, *g*. Corpora quadrigemina. *c h i*. Fillet. *h*. Part which goes to cerebral peduncle. *i*. Part going to corpora quadrigemina. *m m′*. Transverse fibres of pons, cut through. *n*. Inferior peduncle of cerebellum. *o*. Septal fibres of medulla oblongata. *q q*. Fibres of inferior peduncle continued into cerebellum. *r r*. Superior peduncle. *t*. Fasciculi teretes. *u*. Thalamus. *v*. Corpus albicans.

They pass upwards into the middle part of the cerebellum, in the folia of which they are distributed, especially to those of the upper surface.

superior.

The *superior* peduncles, figs. 176, *f*, 180, *r*, which are placed nearest to the middle line, are principally connected with the folia of the inferior vermiform process; but a considerable number of them pass into or issue from the grey capsule of the corpus dentatum which has been already described.

INTERNAL STRUCTURE OF THE CEREBRUM.

The white matter of the encephalon consists of tubular fibres, in general still smaller than those of the cord, and still more prone to become varicose. The general direction which these follow is best seen in a brain that has been hardened by immersion in spirits, although it is true that we do not then trace the single fibres, but only the fine bundles and fibrous lamellæ which they form by their aggregation. The following account of their course and apparent connections has been made out in this manner.

Fibres of cerebrum; form three principal systems: ascending, transverse, and collateral.

The fibres of the cerebrum, though exceedingly complicated in their arrangement, and forming many different collections, may be referred to three principal systems, according to the general course which they take, viz.— 1. *Ascending* or *peduncular fibres*, which pass up from the medulla oblongata to the hemispheres, and constitute the two crura or peduncles of the cerebrum. They increase in number as they ascend through the pons, and still further in passing through the optic thalami, and striated bodies, beyond which they spread in all directions into the hemispheres. These were named by Gall the *diverging* fibres. 2. *Transverse* or *commissural* fibres, which connect the two hemispheres together. These are the converging fibres of Gall. 3. *Longitudinal* or *collateral* fibres, which, keeping on the same side of the middle line, connect more or less distant parts of the same hemisphere together.

Ascending peduncular fibres.

1. The *peduncular* fibres consist of a main body and of certain accessory bundles of fibres.

Main body.

a. The *main body* on each side is derived from the anterior pyramid, fig. 176, *a*, from the prolongation of the lateral column (one of the fasciculi teretes, fig. 181, *a*), and from the posterior pyramid, *p*. After it has passed through the pons and become increased in amount, it is separated

into two parts in the crus cerebri by a layer of dark cineritious matter, named *locus niger*. The lower or superficial part, which is derived from the pyramid, consists almost entirely of white fibres, collected into coarse fasciculi, and is named the *crust* or *basis*, fig. 176, *g*, or the *fasciculated portion* of the peduncle (Foville). The upper part, composed principally of the fasciculus teres and posterior pyramid, is named the *tegmentum*, fig. 181, *b*; it is softer and finer in texture, and is mixed with much grey matter.

separated into two parts by grey deposit, or locus niger.

Fig. 181.*

White fibres form crust and tegmentum.

Still increasing in number within the peduncle, these two

Course

* Back view of peduncular fibres of cerebrum, attached to hemispheres—(Arnold). *a*. Fasciculus teres of left side. *b*. Fibres of tegmentum ascending through thalamus. *c*. Left corpora quadrigemina. *e*. Restiform body. *f f*. Superior peduncles of cerebellum—processus ad testes. *g*. Fibres of crust. *i i*. Fillet of both sides. *k k'*. Corpora striata :—on the right side, the grey matter stripped off to show radiating fibres of fibrous cone. *l*. Left thalamus. *m m*. Sections of middle peduncles of cerebellum. *n*. Section of left inferior peduncle. *p*. Left posterior pyramid. *q*. Corpus callosum. *s*. Under surface of same—below, *s*, cavity of fifth ventricle. *t*. Left anterior pillar of fornix. *y y*. Decussation of radiating fibres, with those of corpus callosum.

through thalami and corpora striata;

sets of fibres continue to ascend, fig. 176, *g*, and pass above the optic tracts through the thalamus, fig. 181, *b l*, and corpus striatum, *k h*. Receiving fresh accessions of fibres there, they are continued on into the medullary substance of the corresponding hemisphere, fig. 176, *h y*.* The anterior fibres, or those of the crust, *g*, pass principally, if not entirely, through the corpus striatum. The posterior fibres, or those of the integumentum, *r*, run, some through the thalamus, *l*, but the greater part at least through the corpus striatum also.

intersect in those bodies,

and also with fibres of corpus callosum.

Reach convolutions.

As they pass through these large grey masses or ganglia, the two sets of fibres intersect or cross each other, and on emerging beyond the grey matter, fig. 181, *y*, they again decussate with the commissural fibres or transverse fibres, *s*, of the corpus callosum, *q*. After that, they spread into the hemisphere in every direction, and reach the cortical substance of the convolutions.

Accessory fibres to peduncles.

The accessory fibres of the peduncular system are as follows :—

Processus ad testes.

b. The superior peduncles of the cerebellum, (processus ad testes,) figs. 176, 181, *f*, which are continued up beneath the corpora quadrigemina, *c*, and form part of the tegmentum.

The fillet.

c. The bundle of fibres on each side, named the *fillet*, lemniscus, schleife, *i*.—This, which is originally derived from the anterior column of the cord, forms the olivary fasciculus, fig. 180, *c*, of the medulla oblongata, as previously described. Reinforced by fibres from the corpus dentatum of the olivary body, *d*, it ascends through the back part of the pons, still increasing in size. Appearing at the side of the cerebral peduncle, above the upper border of the pons, fig. 181, *i i*, it divides into two portions, of which one, fig. 180, *i*, crosses over the superior peduncle of the cerebellum, to the corpora quadrigemina, meeting its fellow of the opposite side ; whilst the other, *h*, is continued upwards with the fibres of the tegmentum.

Fibres from corpora quadrigemina,

d. Other accessory fibres to the peduncles take their rise in the grey matter of the corpora quadrigemina, *g*, *f*, (the *brachia*,) and proceed on to the thalami, *u*.

and corpora geniculata.

e. Lastly, another set, having a similar destination, are derived from the corpora geniculata.

* The continuity of fibres in the hemispheres with those coming from below to the corpora striata is doubted by many authors, and among them by Kölliker.

Corpus striatum and *corona radiata*.—The principal mass of each corpus striatum is concealed in the substance of the cerebral hemisphere, whilst a part of it, fig. 181, *k k*, appears in the lateral ventricle. The ascending white fibres of the corresponding peduncle, spreading out in a radiating manner, pass up, through and between these two parts of the corpus striatum, and divide the grey matter into an extra- and an intra-ventricular portion; the former sometimes named *nucleus lenticularis*, and the latter *nucleus caudatus*. **Corpus striatum, divided into two portions by peduncular fibres,**

The assemblage of these radiating fibres, fig. 176, *g* to *y y*, might be compared to a fan, bent into the form of an incomplete hollow cone, having its concave surface turned downwards and outwards; hence the names *corona radiata* (Stabkranz) applied to them by Reil, and *fibrous cone* by Mayo. On cutting through the corpus striatum across the direction of these fibres, the section of the fibrous cone appears as a broad white band, extending from the anterior to the posterior extremity of that grey mass, and separating it into its outer and inner portions already mentioned. On dissecting the corpus striatum from the ventricle, and removing its intraventricular grey substance, we meet, at some depth from the surface, with these white fibres, which being intermixed with the grey matter, give to the body its streaked appearance. The extraventricular portion, which lies somewhat lower than the inner portion, is situated between the radiating peduncular fibres, and the island of Reil, and may be exposed by dissecting the hemisphere from the Sylvian fissure. In this dissection, the convolutions of the island are first removed; beneath the white matter of those gyri, a thin layer of grey substance is met with, which has been named the *claustrum* (Burdach): deeper than this, white matter again appears,—forming, however, but a very thin layer,—on removing which the extraventricular portion of the corpus striatum is exposed. In this dissection the striated body is also seen to be continuous below with the anterior perforated space, where the grey matter reaches the surface of the brain; whilst around its upper margin, now completely exposed, appears a zone of white radiating fibres, which is the continuation of the corona radiata, after its passage through the grey matter. On next scraping away the latter, the fibrous cone is entirely displayed from its outer side. In doing this, the fibres of the anterior commissure, of which we shall presently make mention, also come into view.

which here form the corona radiata.

Dissection of corpus striatum from Sylvian fissure.

Is covered by grey layer or claustrum.

Is immediately over anterior perforated space.

Lastly, it may be mentioned, that if the brain be cut through in a plane perpendicular to the surface of the island, the section of the grey layer, named the claustrum, appears as a narrow dark line situated between the island and the corpus striatum.

Transverse fibres of cerebrum.

2. The *transverse commissural* or connecting fibres of the cerebrum include the following sets :—

Those of corpus callosum,

a. The cross fibres of the corpus callosum, fig. 181, *q.*—These are more numerous at each end of the corpus callosum than in the middle, and form the thickest mass behind. Passing laterally into the substance of the hemispheres, some are directed upwards, whilst others spread outwards on the roof of the lateral ventricles, forming there what is named the *tapetum*, *s.* Having next intersected the peduncular radiating fibres at *y y*, they then spread out into the hemispheres, reaching the grey matter of the convolutions.

form the tapetum.

Anterior commissure, reaches a long way in brain;

b. The *anterior commissure*, fig. 182, *x.*—This is a round bundle of white fibres, seen in the fore part of the third ventricle, from which it passes laterally into the corpora striata, and bending backwards, extends a long way in the hemispheres, reaching into the middle lobe on each side.

posterior commissure, only a short distance.

c. The *posterior commissure*, also situated in the third ventricle, runs through the optic thalami, and is soon lost in the substance of the hemispheres in that situation.

Collateral fibres of cerebrum.

3. The third system of fibres in the cerebrum, the *longitudinal* or *collateral*, may be comprehended under the following heads.

Those of fornix extend from thalamus

a. The *fornix*, fig. 183, *t t′*.—This forms a longitudinal bundle on each side, which, as already mentioned, might be described as commencing in the thalamus, *, near its anterior tubercle. It then descends to the corpus albicans, *n*, of its own side, turns round in that eminence, and ascending to form the anterior pillar, *t*, may thence be traced backwards in conjunction with that of the opposite side, until it separates posteriorly, where it spreads out in part upon the pes hippocampi in the descending cornu of the lateral ventricle, and is prolonged as the corpus fimbriatum nearly to the point of the middle lobe.

to point of middle lobe.

Fibres of tænia, and pineal peduncles.

b, c. The white fibres constituting the *tænia semicircularis*, fig. 171, *s*, and those of the peduncles of the pineal gland, fig. 174, *p*, may perhaps be regarded as accessories to the fornix. They both join its anterior pillars in front. Behind, the tænia is lost on the back of the thalamus in the

descending cornu; and the pineal peduncles end in the pineal gland, so that they are regarded by some as forming a transverse commissure.

Fig. 182.*

Foville traces the tænia from part of the posterior pyramids, as will be presently noticed.

d. The *striæ longitudinales*, upon the upper surface of the corpus callosum, also belong to this system. They are distinguished into the middle and lateral longitudinal striæ. In front, they are connected with the peduncles

Longitudinal fibres of corpus callosum.

* Under surface of left hemisphere dissected.—(After Mayo.) *a.* Anterior, and *a′*, posterior part of fillet of corpus callosum. *b, g.* Section of cerebral peduncle. *b.* Tegmentum. *g.* Crust, separated by locus niger. *c′.* Fibres reaching from back of corpus callosum to posterior lobe. *e.* Fasciculus uncinatus, connecting anterior and middle lobes, across the Sylvian fissure. *f f.* Transverse fibres from corpus callosum. *l.* Back of thalamus. *m.* Corpus albicans. *q.* Corpus callosum. *r.* Radiating fibres of hemisphere. *t.* Anterior pillar of fornix. *v.* Collateral fibres of convolutions. *x.* Anterior commissure. 2. Part of optic tract.

of the corpus callosum, and through them with the anterior perforated space. Their posterior connections are uncertain; according to Foville, they join the posterior pillars of the fornix.

Fibres of gyrus fornicatus; their great extent;

e. Fibres of the gyrus fornicatus; fillet of the corpus callosum (Mayo).—These fibres constitute the white substance of the gyrus fornicatus, and take a longitudinal course, fig. 183, *a a′*, *a a″*, immediately above the transverse fibres

Fig. 183.*

of the corpus callosum, *q*. In front, *a*, they bend downwards within the gyrus to which they belong, and are connected with the anterior perforated space, being joined by certain longitudinal fibres, which run along the under surface of the corpus callosum near the middle line, passing near and upon the upper edge of the septum lucidum. Behind, *a*, *c*, they turn round the back of the corpus callosum and descend to the point of the middle lobe, *a″*, where, according to Foville, they again reach the perforated space. Offsets, *c c c*, from these fibres pass upwards and

send offsets into convo-

* Dissection of fibres of gyrus fornicatus, and of fornix. (From Foville, slightly altered.) A. Anterior, B. Posterior lobe. *a a′ a″*. Fibres of gyrus fornicatus. *c*. Of its accessory gyri. *b*. Tegmentum; and *g*. crust—the two separated by locus niger. *l*. The thalamus. *n*. Corpus albicans. *q*. Corpus callosum. *r*. Radiating fibres of hemisphere. *s*. Septum lucidum. *t*. fornix. *t′*. Anterior pillar. * Commencement in thalamus. 1. Olfactory nerve. 2. Optic commissure.

backwards into the secondary convolutions in the longitudinal fissure derived from the gyrus fornicatus. lutions of inner surface.

f. Fasciculus uncinatus.—Under this name is described a white bundle, fig. 182, *e*, seen on the lateral aspect of the hemisphere, passing across the bottom of the Sylvian fissure, and connecting the anterior with the middle and posterior lobes. The fibres of this bundle expand at each extremity, and the superficial portion of them curve or hook sharply between the contiguous parts of the anterior and middle lobes,—whence it has received its name. Fasciculus uncinatus in Sylvian fissure; connects anterior and middle lobes.

g. The convolutions of the cerebrum are connected with each other by white fibres, which lie immediately beneath the cortical substance. Some of them, fig. 182, *v*, pass across the bottom of a sulcus between adjacent convolutions; whilst others, which are long and run deeper, connect convolutions situated at a greater distance from one another. Collateral fibres of convolutions.

The central part of the white substance of each convolution is formed by fibres having a different origin; some, fig. 176, *h'*, being derived from the radiating peduncular fibres, and, according to most anatomists, others from the transverse fibres of the corpus callosum. Central fibres of convolutions.

The researches of Foville have led him to differ considerably from other anatomists, as to the course of the fibres of the cerebrum, as will be seen from the following statement of his views :— Foville's views of fibres of cerebrum.

1. The *crust* or *fasciculated portion* of each cerebral peduncle, derived from the anterior pyramid, forms by itself the peduncular fibrous cone, and is thence continued on into the radiating fibres of the cerebrum, which are destined only for the convolutions on the convex surface of the hemisphere, including the outer half of the marginal convolution of the longitudinal fissure, and the inner half of the convolution of the Sylvian fissure. Fibres of crust form radiating set; go only to part of convolutions.

2. The fibres of the *tegmentum*, having entered the thalamus, pass on in two ways—no part of them, be it observed, joining the radiating peduncular fibres. Fibres of tegmentum surround the radiating set.

a. One set pass upwards through the thalamus and corpus striatum, above which they then turn inwards, and, joining with those of the opposite side, form the transverse fibres of the corpus callosum. The corpus callosum is therefore regarded as a commissure of the cerebral peduncles only—none of its cross fibres spreading into the convolutions, as is generally believed. None go direct to convolutions.

b. The second set of fibres of the tegmentum, corresponding with the fasciculi teretes and part of the posterior pyramids, run forwards near the middle line, along the under side of the third ventricle and corpus striatum, through the grey matter in front of the pons, to the anterior perforated space. The remaining part of the posterior pyramid forms the tænia semicircularis, which, passing down in front of the anterior Part surround thalami, corpora striata and ventricles, and form corpus callosum;

others reach anterior perforated space. pillar of the fornix, also reaches the perforated space. From this space more fibres are reflected upwards on the sides of the corpus striatum to join the corpus callosum.

Connected with these are longitudinal arched fibres: 3. As dependencies of the posterior peduncular fibres, and connected with them at the borders of the anterior perforated space, are :—

a. Several sets of longitudinal arched fibres, which embrace, in a series of rings, the radiating peduncular system. These are—the deep fibres of the tænia semicircularis—a somewhat similar band beneath the outer part of the corpus striatum—the half of the fornix with the corpus fimbriatum—the longitudinal fibres placed on the upper and under surface of the corpus callosum, and those of the septum lucidum and, lastly, two remarkable systems of longitudinal fibres—one constituting the entire white substance of the gyrus fornicatus (from end to end), also, of its accessory convolutions, and of the inner half of the marginal convolution of the longitudinal fissure; and the other, forming the white substance of the convolutions of the island of Reil, and the adjoining half of the convolution of the Sylvian fissure. None of the parts just named receive fibres from the radiating peduncular set.

one arch forms white substance of several convolutions.

Also other fibres lining ventricles, *b.* In connection with this system is a thin stratum of white fibres, found upon the internal surface of the ventricles, and prolonged through the transverse fissure into the reticulated white substance covering the lower end of the gyrus fornicatus; whence, according to Foville, it extends, as an exceedingly thin layer of medullary matter, all over the cortical substance of the hemisphere.

and covering convolutions.

Anterior commissure. *c.* The anterior commissure does not reach the convolutions, but radiates upon the outer sides of the corpora striata and thalami.

Grey matter of encephalon; *Grey matter of the encephalon.*—Considering the imputed physiological importance of the grey nervous substance, it may be well to mention connectedly the different positions in which it is found in the several parts of the encephalon.

its position on surface. By far the larger amount is situated upon the convoluted surface of the cerebrum and the laminated surface of the cerebellum, forming in each case the external cortical layer of cineritious matter.

Cortical grey matter of cerebellum. The cortical grey matter which covers the foliated surface of the cerebellum is made up of the following elements, viz.: 1. Pellucid cells of considerable size. 2. Cells, for the most part of large size, and caudate, having the usual granular contents. The cells are imbedded in a finely-granular matrix; the greater number of those of the caudate kind have a pyriform shape, and are prolonged at their small end into a simple or branched appendage, and this process, as first remarked by Purkinje, is in most of them directed towards the surface of the cerebellum. 3. Small bodies like cell-nuclei densely aggregated without any intervening substance. These lie at some depth from the

surface; according to Dr. Todd, they form a thin light-coloured lamina, intermediate between two darker strata of grey matter which contain the nerve-cells; one of these grey strata being next the white matter of the cerebellum, while the other, which is the deeper coloured of the two, is in contact with the pia mater. 4. Fibres. Tubular nerve-fibres pass from the white into the grey matter, and extend through it nearly as far as the surface. According to Valentin, they form loops and return, but this statement has not been confirmed by other observers.

Of cerebrum.

The grey matter on the convoluted surface of the cerebrum is divided into two, and in some regions into three, strata, by interposed thin layers of white substance. In examining it from without inwards, we meet with, 1, a thin coating of white matter situated on the surface, which on a section appears as a faint white line, bounding the grey substance externally (fig. 184, A, *a*). This superficial white layer is not equally thick over all parts of the cortical substance, but becomes thicker as it approaches the borders of the convoluted surface; it is accordingly less conspicuous on the lateral convex aspect of the hemispheres, and more so on the convolutions situated in the longitudinal fissure which approach the white surface of the corpus callosum, and on those of the under surface of the brain. It is especially well marked on the middle lobe, near the descending cornu of the lateral ventricle, where the convoluted surface is bounded by the posterior pillar of the fornix, and it has been there described under the name of the reticulated white substance. It consists of remarkably fine tubular fibres, for the most part varicose, which run parallel with the surface of the convolutions, but intersect each other in various directions. The termination and connections of these fibres are unknown. This superficial white layer contains also a few small cells, with processes; and an abundant granular matrix. 2*ndly*. Immediately beneath the white layer just described, comes a comparatively thick layer of grey, or reddish grey, matter (fig. 184, A, *b*), the colour of which, as indeed of the grey substance generally, is deeper or lighter according as its very numerous vessels contain much or little blood. Then follow, 3*rdly*, another thin whitish layer (*e*), and, 4*thly*, a thin grey stratum (*f*); this last lies next to the central white matter of the hemisphere: Remak considers it as

similar in nature to the gelatinous substance of the spinal cord. According to this account, the cortical substance

Fig. 184.*

consists of two layers of grey substance, and two of white; but in several convolutions, especially those situated near the corpus callosum, a third white stratum may be seen (indicated by *c* at the lower end of the figure), which divides the most superficial grey one into two (*b* and *d*), thus making six in all, namely, three grey and three white.

The cortical grey substance consists of nerve-cells of rather variable size; angular, fusiform, round or oval in shape, and for the most part caudate, lying in a gra-

* A. Section of the grey substance of the convolutions of the cerebrum. At the upper part of the figure *a* and *e* are two white, and *b* and *f* two grey strata. At the lower part of the figure an additional white layer (*c*) divides the first grey layer into two, *b* and *d*. (From Remak.)

B. Plan to show the general arrangement of the fibres and cells in the cortical substance. The letters *a*, *b*, *c*, *d*, *e*, *f*, indicate the same strata as in figure A; *g* shows fibres coming from the central white matter of the brain, and intersecting the stratified white fibres of the cortical substance. (Remak.)

nular matrix; also of small nucleus-like vesicles, like those seen in the cortical substance of the cerebellum, and, according to Dr. Todd, here also collected into a special stratum. In the middle grey layer, the cells are of variable size, some being so small as to resemble nuclei; but others of much larger dimensions are abundant; and, according to Kölliker, present from one to six processes. In the innermost grey layer the cells have similar characters, but often contain pigmentary matter. Tubular fibres exist throughout; one set of them run parallel with the surface, and at certain depths are more densely aggregated, so as to form the before-mentioned white layers (fig. 184, B, *a*, *c*, *e*); but they are not wanting in the intervening grey strata (*b*, *d*, *f*), only they are there wider apart. The manner in which they begin and end is not known; it seems not improbable, however, that they are dependencies of the commissural system of fibres. These stratified fibres, if they might be so called, are intersected by another set of tubular fibres (*g*), which come from the central white mass of the hemispheres, and run perpendicularly through the cortical substance, becoming finer and spreading more out from each other as they approach the surface.

The further disposition of these central or perpendicular fibres is uncertain; Valentin describes them as forming terminal loops or arches, but this is denied by Remak and Hannover. Remak states that they gradually disappear from view at different depths, as they pass through the successive layers, the last of them vanishing in the superficial grey stratum; but he is unable to say positively how they terminate: it sometimes seemed to him as if the last of them, after intersecting the fibres of the deeper white strata, became continuous with those of the outermost layer; but of this he by no means speaks confidently. Hannover maintains that they are connected at their extremities with the nerve-cells in the cortical substance.

Grey matter at base of brain;

In the middle part of the base of the brain it is seen to be accumulated along the under side of the third ventricle in a layer of varying thickness extending from a little above the optic commissure to the back part of the interpeduncular space, forming the lamina cinerea, the tuber cinereum, and the grey matter in the posterior perforated space, the infundibulum and pituitary body being continuous with it below. Towards each side, in front, the lamina cinerea is connected with the grey matter of the anterior perforated space, whence a continuity of the cineritious substance may be traced forwards into the olfactory nerve, as far as its

in interior of brain; obtuse extremity, the olfactory lobe. Moreover, this median stratum of grey matter seen on the floor of the third ventricle is prolonged upwards on the sides of the thalami, passes across as the soft commissure, partly surrounds the anterior pillar of the fornix, (having entered below into the interior of the corpus albicans,) and is extended higher up on the sides of the septum lucidum. In the crura cerebri, the grey matter is collected into a dark mass, the locus niger, and is also diffused among the fasciculi of the tegmentum; below this it is continuous with that of the pons and medulla oblongata, and through them with that of the spinal cord, as has already been sufficiently described.

in peduncles of brain;

in pons, medulla, and spinal cord.

In the centre of each of the corpora quadrigemina, grey matter is also found, and this collection is stated by Huschke to be continuous below with the posterior cornu of the grey matter of the spinal cord, posteriorly with that of the corpus dentatum of the cerebellum, and anteriorly with the soft commissure, the septum lucidum, optic thalami, and corpus callosum. Grey matter occurs also in the pineal gland, and in the corpora geniculata. These last bodies appear to be appendages of the large masses of grey matter situated in the interior of the cerebrum, named the optic thalami; which again are succeeded by the still larger collections of this substance, and indeed the largest situated within the brain, viz. the corpora striata. The grey matter of each corpus striatum is continuous below with that of the anterior perforated space; and on its outer side is the thin layer of grey matter named the claustrum, the connections of which are not well understood.

In corpora quadrigemina and geniculata;

in thalami and corpora striata.

With regard to the structure of these internal collections of grey matter it may be remarked that they consist of nerve-cells and intercellular granular matter, with tubular fibres in greater or less number: the following details respecting them are given chiefly on the authority of Hannover:—

The corpus striatum and optic thalamus contain cells very much like those of the cortical substance. In the corpora quadrigemina there are larger cells, approaching in size to those of the cerebellum, besides very small cells and nucleiform bodies. The dark matter, forming the so-called locus niger of the cerebral peduncles, and that in the floor of the fourth ventricle, contain caudate cells, many of them of the largest size, with long appendages, and deeply coloured with pigment. In the pineal gland the cells are larger than those of the cerebral convolutions, but with comparatively small nuclei, and many of them contain

particles of earthy matter; there are but few of the nucleus-like corpuscles. The anterior lobe of the pituitary body (p. 461) contains dark nerve-cells of moderate size, with coarsely granular contents, along with isolated nucleiform bodies. The posterior lobe, on the other hand, consists of very large cells of soft consistence and variable irregular shape, containing comparatively small nuclei without nucleoli. Many of these last-mentioned cells are furnished with appendages, and it is not uncommon to meet with two united together by a sort of commissure.

In the centre of each hemisphere of the cerebellum is the corpus dentatum. In cerebellum.

CONNECTIONS OF THE CRANIAL NERVES WITH THE ENCEPHALON.

The *cranial* nerves arise from the under part of the brain and issue through the foramina in the base of the skull. They are usually reckoned as forming *nine* pairs (see fig. 169, where they are numbered [1] to [9]). The several designations of these nerves as well as their course within the cranium will be subsequently described. It is here proposed to give an account of their connections with the encephalon, or what is usually called their root or *origin*. Cranial nerves are nine pairs.

The roots of the nerves may be traced for some depth into the substance of the encephalon, a circumstance which has led to the distinction of the *deep* or *real* origin, and the *superficial* or *apparent* origin, by which latter is understood the place at which the nerve appears attached to the surface of the encephalon. The superficial origin of these nerves is quite obvious, but their deeper connection, is in most cases, a matter of much uncertainty. For this reason the apparent origin is described before the deep origin, which is less perfectly known. Origins are deep or superficial.

1. The first or *olfactory* nerve, figs. 169, 170,[1], small in man in comparison with animals, lies on the under surface of the anterior lobe to the outer side of the longitudinal median fissure, lodged in a sulcus between two straight convolutions. Unlike other nerves, it consists of a large proportion of grey matter mixed with white fibres, and, indeed, is rather to be considered a prolongation of the anterior lobe. It enlarges into a *bulb*, *olfactory bulb*, in front, which also contains much grey matter, and from this part small soft nerves descend through the cribriform plate of the skull into the nose. On turning back the bulb, it is seen that the nerve behind that part is three-sided, its First pair, or olfactory nerves, are prolongations of cerebrum. Olfactory bulb.

upper edge lying in the groove or sulcus above-mentioned. When traced backwards, it is found to be spread out and attached behind to the under surface of the anterior lobe by means of *three* portions or *roots*, named external, middle, and internal, which pass in different directions.

Nerve has three roots:

external or long;

The *external* or *long* root consists of a band of medullary fibres, which passes, in the form of a white streak, outwards and backwards along the anterior margin of the perforated space, towards the posterior border of the Sylvian fissure, where it may be followed into the substance of the cerebrum. Its further connections are doubtful, but it has been stated that its fibres have been traced to the following parts, viz., the convolutions of the island of Reil, the anterior commissure, and the superficial layer of the optic thalamus (Valentin).

middle or grey;

The *middle* or *grey* root is of a pyramidal shape, and consists of grey matter on the surface, which is prolonged from the adjacent part of the anterior lobe and perforated space. Within it there are white fibres, which have been traced to the corpus striatum.

internal or short.

The *internal root* (*short* root, Scarpa), which cannot always be demonstrated, is composed of white fibres which may be traced from the inner and posterior part of the anterior lobe, where they are said by Foville to be connected with the longitudinal fibres of the gyrus fornicatus.

Second pair, or optic nerves.

2. The *second* pair of nerves, or the *optic* nerves, [2], of the two sides meet each other at the optic commissure (chiasma), *c*, where they partialy decussate. From this point they may be traced backwards around the crura cerebri under the name of the optic tracts.

Origin from brain by optic tracts.

Each *optic tract*, *u*, arises from the optic thalamus, the corpora quadrigemina, and the corpora geniculata. As it leaves the under part of the thalamus, it makes a sudden bend forwards and then runs obliquely across the under surface of the cerebral peduncle, fig. 185, [2], in form of a flattened band, which is attached by its anterior edge to the peduncle ; after this, becoming cylindrical, it adheres to the tuber cinereum, from which and, as was first pointed out by Vicq-d'Azyr,* from the lamina cinerea it is said to receive an accession of fibres, and thus reaches the optic commissure.

Structure of

In the *commissure* the nerves of the two sides undergo a

* Op. cit. p. 72, pl. xxi.

partial decussation. The outer fibres of each tract continue on to the eye of the same side; the inner fibres cross over to the opposite side; and fibres have been described as running from one optic tract to another along the posterior part of the commissure, and others between the two optic nerves in its anterior part (Mayo). optic commissure.

In front of the commissure, the nerves enter the foramen opticum, receiving a sheath from the dura mater and acquiring greater firmness.

The fibres of origin of the optic tract from the thalamus are derived partly from the superficial stratum, and partly from the interior of that body. According to Foville, this tract is also connected with the tænia semicircularis, and with the termination of the gyrus fornicatus; and he states further, that where the optic tract turns round the back of the thalamus and the cerebral peduncle it receives other delicate fibres, which descend from the grey matter of those parts.—(Op. cit. p. 514.)

3. The *third pair* of nerves, [3], (motores oculorum,) have their *apparent* or superficial origin from the inner surface of the crura cerebri in the interpeduncular space, immediately before the pons, fig. 185, [3]. Each nerve consists of a number of funiculi which arise in an oblique line from the surface. Third pair, or motor nerves of eye:

As to their *deep* connections,—the fibres of origin are found to diverge in the substance of the crus, some being traced to the locus niger, others running downwards in the pons amongst its longitudinal fibres, and others, again, turning upwards to be connected with the corpora quadrigemina and Vieussenian valve. According to Stilling, with whom Kölliker agrees, the major part of the fibres arise from a grey nucleus in the floor of the Sylvian aqueduct, close to the origin of some fibres of the fourth nerve. their deep origin.

4. The *fourth* pair, *pathetic* or *trochlear* nerves, figs. 169, 185, [4], the smallest of those which are derived from the brain, are seen at the outer side of the crura cerebri immediately before the pons. Each nerve may be traced backwards round the peduncle to below the corpora quadrigemina, where it arises from the upper part of the valve of Vieussens, fig. 174. Kölliker states that under the corpora quadrigemina the fibres of origin are distributed in two bundles; the anterior being traceable through the lateral wall of the aqueduct of Sylvius to its floor, where it arises from a grey nucleus close to the middle line; the posterior bundle being derived from a grey nucleus in the floor The fourth pair, or pathetic nerves, are very small Deep origin.

of the fourth ventricle, close to the origin of the fifth. The roots of the nerves of opposite sides are connected together across the middle line in the form of a white band or commissure in the substance of the velum.

Fifth pair or trigeminal nerves.

Superficial origin.

Fig. 185.*

5. The *fifth* pair of nerves, *par trigeminum*, *trifacial nerves*. The superficial origin of these nerves, figs. 169, 185, [5], is from the side of the pons Varolii, where the latter is connected with the middle crus cerebelli, considerably nearer to the upper than to the lower border of the pons.

Arises by two roots: the smaller or motor; the larger or sensory.

The fifth nerve consists of a larger or sensory, and a smaller or motor root, fig. 185. The smaller root is at first concealed by the larger, and is placed a little higher up, there being often two or three cross fibres of the pons between them. On separating the two roots, the lesser one is seen to consist of a very few funiculi. In the *larger* root the funiculi are numerous, amounting sometimes to nearly a hundred. This root acquires its neurilemma sooner at the circumference than in the centre, so that the outward cords are longer than those within, and when the bunch of funiculi is pulled away, a small conical eminence of white substance remains behind.

The deep connection,

Deep origin.—The *greater* root runs beneath the transverse fibres of the pons towards the lateral part of the medulla oblongata behind the olivary body. Several anatomists trace it into the floor of the fourth ventricle, between the

* Front view of crura cerebri, pons, medulla oblongata, and part of spinal cord (Bell). The origins of some of the cranial nerves are shown. 2. Optic nerve. 3. Motor oculi. 4. Pathetic nerve. 5. Fifth, or trifacial nerve. 6. Abducent nerve. 7. Auditory and facial nerves—seventh pair. 8. Eighth pair, including glosso-pharyngeal, vagus and spinal accessory nerves. 9. Hypoglossal nerve. 1. A spinal nerve.

fasciculi teretes and the restiform bodies. By some it is considered to be continuous with the fasciculi teretes and lateral columns of the cord, whilst others connect it with the grey mass which is regarded by Stilling as the nucleus of the glosso-pharyngeal nerve. of large root,

The *motor* root was supposed by Bell to descend to the pyramidal body, and Retzius believes that he has confirmed that opinion by dissection : but the deep connection of this root is not known with certainty. According to Stilling the fibres pass through the pons to the floor of the fourth ventricle, and have their origin in its grey matter. of small root.

According to Foville, some of the fibres of the sensory root of the fifth nerve are connected with transverse fibres in the pons, whilst others spread out on the surface of the middle peduncle of the cerebellum, and enter that part of the encephalon beneath the folia.—(Op. cit. p. 506.)

6. The *sixth* nerve (abducens), *motor oculi externus*, figs. 169, 185, [6], takes its apparent origin from between the pyramidal body and the pons Varolii by means of a large and a smaller bundle. It really arises from the pyramid, and to a small extent from the pons also. Phillipeaux and Vulpian, with whom Kölliker concurs, state that the fibres may be traced to the floor of the fourth ventricle. (Canstatt and Köll. Mik. An.) Sixth pair, or abducent nerves.

7. The *seventh* pair of nerves, [7 7'], appear on each side at the posterior margin of the pons, opposite its junction with the middle peduncles of the cerebellum, and therefore in a line with the place of attachment of the fifth nerve. The seventh nerve is divided into two perfectly distinct portions, which, in fact, are two different nerves : the one, named the portio dura, is the muscular nerve of the face ; the other, or portio mollis, is the nerve of hearing. Seventh pair, consists of two distinct nerves:

The *portio dura* or *facial* nerve, [7], placed a little nearer to the middle line than the portio mollis, may be traced to the medulla oblongata between the restiform and olivary fasciculi, with both of which it is said to be connected. Some of its fibres are derived from the pons. Phillipeaux and Vulpian affirm that they arise from the outer wall of the fourth ventricle, and that many of them decussate in its floor. portio dura, or facial nerve;

Connected with the portio dura, and intermediate between it and the portio mollis, is a smaller white funiculus, first described by Wrisberg (portio inter duram et mollem). The

roots of this accessory portion are connected deeply with the lateral column of the cord.

and portio mollis, or auditory nerve.

The *portio mollis*, figs. 169, 185, [7′], or auditory nerve, rises from the floor of the fourth ventricle, at the back of the medulla oblongata, in which situation, as already described, numerous white striæ are seen, which form the commencement of the nerve, fig. 168. These roots are connected with the grey matter, and some appear to come out of the median fissure. The nerve then turns round the restiform body, and becomes applied to the lower border of the pons, receiving accessions from the former of those parts, and according to some authorities from the latter also.

Foville says that the roots of the portio mollis are also connected by a thin layer on the under surface of the middle peduncle with the cortical substance of the cerebellum; also, with the small lobule named the flocculus; and with the grey matter at the borders of the calamus scriptorius.

Eighth pair of nerves consists of three portions, viz.:

8. The *eighth* pair, figs. 169, 185, [8 8′ 8″], of cranial nerves consists of a series of funiculi which arise along a lateral line from the medulla oblongata, and cervical part of the spinal cord.

glosso-pharyngeal,

The uppermost bundle is the *glosso-pharyngeal* nerve, [8]; next to this, and lower down, is the *par vagum* or *pneumogastric* nerve, [8′], consisting of a larger number of white cords. The roots of both these nerves are attached superficially to the fore part of the restiform body. Still lower, is the *spinal accessory* nerve, [8″], which comes up from the side of the spinal cord, enters the skull by the foramen magnum, and is associated with the vagus nerve, as it passes out through the foramen lacerum.

vagus, and spinal accessory.

Apparent origin of spinal accessory.

The accessory nerve arises within the spinal canal from the lateral column of the cord, near the posterior lateral fissure, by a series of slender roots, which commence about as low down as the sixth cervical nerve. The nerve passes upwards between the posterior roots of the cervical nerves and the ligamentum denticulatum,—its several funiculi of origin successively joining it as it ascends. On entering the skull, it receives funiculi from the side of the medulla oblongata.

Deep connections of eighth nerve.

These three portions of the eighth pair are connected *deeply* with grey nuclei within the cord and medulla oblongata, as already fully described (see p. 485).

9. The *ninth* nerve, figs. 169, 185, [9], (hypoglossal,) arises, in a line continuous with that of the anterior roots of the spinal nerves, by scattered funiculi from the furrow between the olivary body and the anterior pyramid. Ninth or hypoglossal nerve;

Its roots are traced by Stilling to one of the grey nuclei already described in the medulla oblongata, and they are said by Kölliker to undergo partial decussation in the floor of the fourth ventricle. Its deep connection.

THE MEMBRANES OF THE BRAIN AND SPINAL CORD.

As already stated, the cerebro-spinal axis is protected by three *membranes*, named also *meninges* (μῆνιγξ). They are :—1. An external fibrous membrane, named the *dura mater*, which closely lines the interior of the skull, and forms a loose sheath in the spinal canal; 2. An internal areolo-vascular tunic, the *pia mater*, which accurately covers the brain and spinal cord; and 3. An intermediate serous sac, the *arachnoid* membrane, which, by its parietal and visceral layers, covers the internal surface of the dura mater on the one hand, and is reflected over the pia mater on the other. Membranes of brain and cord; three in number. Names.

THE DURA MATER.

The *dura mater*, a very strong dense inelastic fibrous tunic, of considerable thickness, is closely lined on its inner surface by the outer portion of the arachnoid, and with it, therefore, forms a *fibro-serous* membrane, which is free, smooth, and epitheliated on its inner surface, where it is turned towards the brain and cord, but which, by its outer surface, is connected in a different manner in the cranium, and in the spinal canal. Dura mater — with arachnoid, is a fibro-serous tunic.

The outer surface of the *cranial* portion adheres to the inner surface of the bones, and forms their internal periosteum. The connection between the two, in a great measure, depends on blood-vessels and small fibrous processes, which pass from one to the other; and the dura mater, when detached and allowed to float in water, presents a flocculent appearance on its outer surface, in consequence of the torn parts projecting from it. In the cranium, forms internal periosteum,

The adhesion between the membrane and the bone is more intimate opposite the sutures, and also generally at the base of the skull, which is uneven, and perforated by adheres closely to bones.

numerous foramina, through which the dura mater is prolonged to the outer surface, being there continuous with the pericranium. The fibrous tissue of the dura mater becomes blended with the areolar sheaths of the nerves, at the foramina which give issue to them.

Sheath for cranial nerves.

In the spine, is a loose sheath.

In leaving the skull, the dura mater is intimately attached to the margin of the foramen magnum; but within the vertebral canal it forms a loose sheath around the cord, (*theca*,) and is not adherent to the bones, which have an independent periosteum. Towards the lower end of the canal a few fibrous slips proceed from the outer surface of the dura mater to be fixed to the vertebræ. The space intervening between the canal and the dura mater is occupied by loose fat, by watery areolar tissue, and by a plexus of spinal veins.

Sheaths for spinal nerves.

Opposite each intervertebral foramen the dura mater presents two openings, placed side by side, which give passage to the two roots of the corresponding spinal nerve. It is continued as a tubular prolongation on the nerve, and is lost upon its sheath. Besides this, it is connected with the circumference of the foramen by areolar tissue.

Consists of two layers: forms sinuses,

The fibrous tissue of the dura mater, especially within the skull, is divisible into two distinct layers, and at various places these layers separate from each other and leave intervening channels, called *sinuses*. These sinuses, which have been elsewhere described, are canals for venous blood, and are lined with a continuation of the internal membrane of the veins.

and three processes or partitions. Their names.

The dura mater also sends inwards into the cavity of the skull three strong membranous *processes*, or *partitions*, which are regarded as duplicatures of its inner layer. Of these, one descends vertically in the median plane, and is received into the longitudinal fissure between the two hemispheres of the cerebrum. This is the *falx cerebri*. The second is an arched or vaulted partition, stretched across the back part of the skull, between the cerebrum and the cerebellum: it is named the *tentorium cerebelli*. Below this, another vertical partition, named *falx cerebelli*, of small extent, passes down between the hemispheres of the cerebellum.

Falx cerebri, divides hemispheres.

The *falx cerebri* is narrow in front, where it is fixed to the crista galli, and broader behind, where it is attached to the middle of the upper surface of the tentorium, along which line of attachment the straight sinus is situated.

Along its upper convex border, which is attached above to the middle line of the inner surface of the cranium, runs the superior longitudinal sinus. Its under edge is free, and reaches to within a short distance of the corpus callosum, approaching nearer to it behind. This border contains the inferior longitudinal sinus.

The *tentorium*, or *tent*, is elevated in the middle, and declines downwards in all directions towards its circumference, in correspondence with the upper surface of the cerebellum. Its inner border is free and concave, and leaves in front of it an oval opening, through which the isthmus encephali descends. It is attached behind and at the sides by its convex border to the horizontal part of the crucial ridges of the occipital bone, and there encloses the lateral sinuses. Farther forward it is connected with the upper edge of the petrous portion of the temporal bone—the superior petrosal sinus running along this line of attachment. At the point of the pars petrosa, the external and internal borders meet, and may be said to intersect each other—the former being then continued inwards to the posterior, and the latter forwards to the anterior clinoid process.

Tentorium, covers cerebellum.

Its attachment in front.

The *falx cerebelli* (falx minor) descends from the middle of the posterior border of the tentorium with which it is connected, along the vertical ridge named the internal occipital crest towards the foramen magnum, bifurcating there into two smaller folds. Its attachment to the bony ridge marks the course of the posterior occipital sinus, or sinuses.

Falx cerebelli.

Structure.—The dura mater consists of white fibrous and elastic tissue, arranged in bands and laminæ, crossing each other. It is traversed by numerous blood-vessels which are destined for the bones. Minute nervous filaments, derived from the fourth and fifth and probably glosso-pharyngeal cranial nerves, and, according to some anatomists, from the sympathetic, are described as entering the dura mater of the brain. Nervous filaments have not been traced in that of the spinal column.

Dura mater is fibrous and carries blood-vessels.

Its nerves.

Glandulæ Pacchioni.—Upon the external surface of the dura mater, in the vicinity of the longitudinal sinus, are seen numerous small fleshy-looking elevations, generally collected into clusters, named glands of Pacchioni. The inner surface of the calvarium is marked by little pits, which receive these eminences. Similar excrescences are seen on the internal surface of the dura mater, and also upon the

Glands of Pacchioni; form and position;

pia mater on each side of the longitudinal sinus: moreover, some project into that sinus itself.

probable mode of growth; It seems probable that these small bodies are originally developed from the pia mater, or arachnoid, and extend themselves through the dura mater to the external surface, causing a partial absorption or separation of the fibres of that membrane. In like manner, those seen in the longitudinal sinus seem to have perforated the dura mater, carrying before them a covering of the venous lining membrane. structure; They consist, according to Valentin, of exudation corpuscles, and, in an older or more advanced condition, are composed of fibres precisely similar to the white fibres of areolar tissue. The cerebral layer of the arachnoid in the neighbourhood of these growths is usually thickened and opaque, and often adheres to the parietal portion.

not found in early age; These bodies are not found at birth; and according to the brothers Wenzel, exist in very small number, if at all, under the third year. Beyond the seventh year they are usually found, and they increase in number greatly as life advances; in some cases, however, they are altogether wanting. In animals there appears to be no corresponding structure.

Similar bodies are often found attached to the choroid plexuses of the fourth ventricle.

are perhaps results of disease. From all the circumstances of their history, these so-called glands of Pacchioni have been regarded by many as the result of a chronic action, producing an unnatural deposit in this situation. They are certainly not glandular in their nature.

THE PIA MATER.

Pia mater covers nervous centres. The *pia mater* is a delicate vascular membrane, richly supplied with vessels, which immediately invests the brain and spinal cord.

On cerebrum; is closely applied. Upon the hemispheres of the brain, it is applied to the entire cortical surface of the convolutions, and dips into all the sulci. From its internal surface a multitude of small vessels enter the grey matter and extend for some distance perpendicularly into the substance of the brain. This Tomentum cerebri; inner surface of the cerebral pia mater is on this account very flocculent, and is named *tomentum cerebri*. On the on cerebellum; cerebellum a similar arrangement exists, but the membrane is finer and the vessels from its inner surface are

not so long. The pia mater is also prolonged into the ventricles and there forms the velum interpositum and choroid plexuses. In ventricles.

Structure.—It consists of interlaced bundles of areolar tissue, conveying great numbers of blood-vessels; and, indeed, its peculiar office, both on the brain and spinal cord, seems to be that of providing a nidus or matrix for the support of the blood-vessels, as these are sudivided before they enter the nervous substance. According to Fohmann and Arnold it contains numerous lymphatic vessels. Purkinje describes a retiform arrangement of nervous fibrils, derived according to Kölliker and others from the sympathetic, the third, sixth, seventh, eighth, and accessorius. Areolo-vascular structure; contains lymphatics.

On the *spinal* cord the pia mater has a very different structure from that which it presents on the encephalon, so that it has even been described by some as a different membrane under the name *neurilemma of the cord.* It is thicker, firmer, less vascular, and more adherent to the subjacent nervous matter: its greater strength is owing to its containing fibrous tissue, which is arranged in longitudinal shining bundles. A process of this membrane dips down into the anterior fissure of the cord, and serves to conduct blood-vessels into that part. At the roots of the nerves, both in the spine and in the cranium, the pia mater becomes continuous with their neurilemma. It is supplied with nerves from the sympathetic. On the spinal cord is thicker: is prolonged on nerves;

Towards the upper part of the cord, the pia mater presents a greyish mottled appearance, which is owing to pigment particles deposited within its tissue. is sometimes stained with pigment.

THE ARACHNOID MEMBRANE.

The *arachnoid* is a very fine delicate serous membrane, which, like other membranes of that class, forms a shut sac, and consists of two portions, viz. a visceral (or cerebral) and a parietal layer. Arachnoid, shut serous sac.

The *parietal* layer, as already said, adheres to the dura mater of the brain and spinal cord,—the adhesion of one membrane to the other being most intimate. Parietal portion.

The *visceral* portion passes over the various eminences and depressions on the cerebrum and cerebellum, without dipping into the sulci and smaller fissures; nor is it uniformly and closely adherent to the pia mater. The interval Visceral portion, in cranium.

left between these two membranes is named generally the subarachnoid space.

Subarachnoid space; in longitudinal fissure,

This *subarachnoid space* is wider and more evident in some positions than in others. Thus,—in the longitudinal fissure, the arachnoid does not descend to the bottom, but passes across, immediately below the edge of the falx, at a little distance above the corpus callosum. In the interval thus left, the arteries of the corpus callosum run backwards along that body. At the *base* of the brain and in the *spinal canal* there is a wide interval between the arachnoid and the pia mater. In the former situation, this subarachnoid space extends over the pons and the interpeduncular space as far forwards as the optic nerves : around the cord, this space is also of considerable extent.

at base of brain, and in spine :

contains fluid;

A certain quantity of *fluid* is contained within the proper sac of the arachnoid ; but it has been shown by Magendie that the chief part of the cerebro-spinal fluid is lodged under the arachnoid, in the subarachnoid space, which usually communicates by an opening at the point of the fourth ventricle with the general ventricular cavity, as elsewhere stated. (Fig. 170, *z*.)

communicates with fourth ventricle.

Subarachnoid space divided by a septum behind.

Magendie also pointed out the existence of a sort of septum dividing the spinal subarachnoid space at the back of the cord. This is a thin membranous partition, which passes in the median plane from the pia mater covering the posterior median fissure of the cord to the opposite part of the loose portion of the arachnoid membrane. It is incomplete and cribriform ; and consists of bundles of white fibres interlaced more or less with one another. Fibrous bands of the same texture pass across the subarachnoid space in various situations both within the spinal canal and at the base of the brain, stretching thus from the arachnoid to the pia mater.*

* I was at one time disposed to think that the subarachnoid space was lined throughout by a delicate serous membrane, and that the septum above described consisted of a duplicature of this membrane, extending from the loose arachnoid to the cord, as the mesentery passes to the intestine. I was led to entertain this idea, on considering that the space in question contains fluid ; that the loose portion of the arachnoid is separable, in many parts, into two layers ; and that a thin membrane can be raised from the surface of the ligamentum denticulatum and the roots of the nerves, as they pass across the space. I have since found, however, that this view will not stand the test of microscopic scrutiny ; for the internal layer has not the defined surface of a serous membrane, but is composed of openly-reticulated bundles of filaments, like areolar tissue.—W. S.

As the cerebral and spinal nerves proceed to their foramina of exit from the cranium and vertebral canal, they are loosely surrounded by tubular sheaths of the arachnoid membrane, which extend along each nerve from the visceral to the parietal layer. Nerves and vessels covered by arachnoid.

Structure.—When examined under the microscope, the arachnoid is found to consist of bundles of fibres like those of fibrous and elastic tissue, interlaced with one another. A simple layer of scaly epithelium can be demonstrated on various parts of its free surface, and probably exists all over. Structure.

Kölliker states that the arachnoid of the dura mater consists only of a layer of polygonal flattened, nucleated, epithelium cells; and that no trace of any other structure is to be found beneath this layer. The visceral fold of the arachnoid has, however, beneath its epithelium a distinct and continuous stratum of connective tissue. Volkmann has described a rich plexus of nerves in the arachnoid membrane of certain ruminants. Kölliker has failed to detect their presence; but they have been again described by Bochdalek, who traces them to the portio minor of the fifth, the facial, and accessorius.

Cerebro-spinal fluid.—This is a very limpid serous fluid, which occupies the subarachnoid space. When collected immediately after death, its quantity was found by Magendie in the human subject to vary from two drachms to two ounces. It is slightly alkaline, and consists, according to an analysis by Lassaigne, of 98·5 parts of water, the remaining 1·5 per cent. being solid matter, animal and saline. In experiments made on the dog, it was found by Magendie to be reproduced in thirty-six hours, after it had been drawn off by puncturing the membranes at the lower part of the cord. Cerebro-spinal fluid: quantity; composition; easily reproduced;

Its chief use is probably mechanical, there being obvious advantages in the delicate structures placed within the cranium and spine being surrounded by a fluid medium. As just now stated, it is rapidly secreted, and perhaps it is also as readily absorbed; and thus, being easily susceptible of changes in its quantity, it may, in this way, admit of variations in the amount of blood circulating in the vessels of the brain and spinal cord, although the cranio-vertebral cavity in which they are lodged does not vary in its capacity. uses.

Ligamentum denticulatum.—This is a narrow fibrous band which runs along each side of the spinal cord in the subarachnoid space, between the anterior and posterior roots of the nerves, commencing above at the foramen magnum, and reaching down to the lower pointed end of the cord. By its inner edge this band is connected with the pia mater of the cord. Its outer margin is widely scolloped or Ligamentum denticulatum.

outer border scolloped; serrated, and the points of its serratures or denticulations are attached, in the intervals between the nerves, to the inner surface of the dura mater, being covered at their insertion by the arachnoid membrane. The first or highest denticulation is fixed opposite the margin of the foramen magnum, between the vertebral artery and the hypoglossal nerve; and the others follow in order, alternating with the successive pairs of spinal nerves. In all, there are about twenty-two of these points of insertion. At the lower end, the ligamentum denticulatum is continued into the terminal filament of the spinal cord, which thus connects it to the dura mater at the lower end of the sheath, and might therefore, although much longer, be compared with its lateral denticulations.

extent of its denticulations;

number—twenty-two.

Consists of fibrous, with elastic tissue.

Structure.—It consists of white fibrous tissue, mixed with many exceedingly fine elastic fibres, seen on applying acetic acid. It is obviously continuous on the one hand with the fibrous tissue of the pia mater, and with that of the dura mater on the other.

The use of the ligamentum denticulatum is obviously to support the cord and its nerves.

Linea splendens.

The pia mater of the cord presents a conspicuous fibrous band, running down in front over the anterior median fissure. This was named by Haller, *linea splendens.*

BLOOD-VESSELS OF THE BRAIN AND SPINAL CORD.

Arteries of brain and cord;

their general position.

The arteries of the brain and in part those of the spinal cord are derived from the internal carotid and vertebral arteries. These vessels having passed across the arachnoid cavity get into the subarachnoid space and then divide and subdivide into branches, which, in their farther course to the nervous centres, are supported by the pia mater, and, it may be remarked, are more deeply placed in the various fissures and sulci than the small veins, which do not accompany the arteries, but pursue a different course and are seen upon the surface of the pia mater.

Veins; their general position.

Moreover, it is also to be observed, that whilst the main branches of the arteries are situated at the base of the brain, the principal veins tend towards the upper surface of the hemispheres, where they enter the superior and inferior longitudinal sinuses: the veins of Galen, however, coming from the lateral ventricles and choroid plexuses, run backwards to the straight sinus.

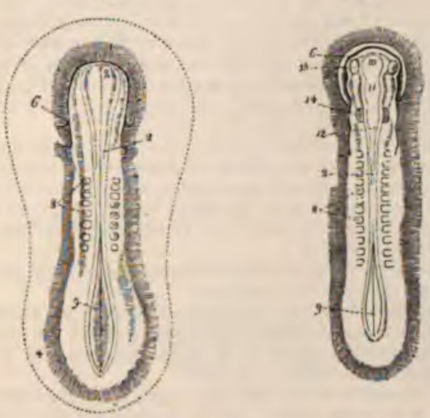
DEVELOPMENT OF THE CRANIO-VERTEBRAL CAVITY.

The cerebro-spinal axis, with the cranio-vertebral cavity surrounding it, is the part of the embryo which first begins to be formed. It commences in the external or serous layer of that portion of the ovum which has been named the blastoderma or germinal membrane, in form of a *groove* dilated at one extremity, and bounded by two ridges named the *dorsal plates* (laminæ dorsales). See fig. 186, and description of that figure.

Vertebral column and nervous centres are first formed in embryo. Primitive groove. Dorsal plates. Commencement of vertebræ.

On each side of the groove, near its middle, the small quadrangular

Fig. 186.*



rudiments of the vertebræ, fig. 186,[8], begin to appear in the substance of the dorsal plates; while a thin portion of each dorsal plate next the groove is destined to form, along with its fellow of the opposite side, the rudiments of the cerebro-spinal axis.

In the progress of development, the dorsal plates unite over the groove, at first in the middle and then at the extremities, and thus

Formation of cranio-

* Shows the early condition of the nervous centres in the embryo of the fowl—(Reichert). A. The sides of the groove have united in a great extent, and converted it into a canal; the dilated cephalic extremity is seen at 2; from 2 to 9 is the groove partly closed; 9 is the open part at the lower end, which remains afterwards as the rhomboidal sinus. 8. Rudiments of the vertebræ.—B. The groove is closed except at 9—the rhomboidal sinus. 8. Plates of vertebræ. 10. Anterior or first vesicle; 11, second or middle; and 12, third or posterior vesicle.

vertebral canal;

convert it into a canal, in which the commencing brain and spinal cord may soon be discovered. The enlarged or cephalic end, A,[2], of this *cranio-vertebral* canal, as it might be named, is dilated into three vesicles, B, [10], [11], [12], which afterwards form the cranial cavity, and in which the encephalon is developed; whilst the remaining part of the canal (the vertebral part) ultimately contains the spinal cord.

of membranes; and of nervous centres.

The matter of which the cerebro-spinal axis is at first composed soon separates, according to Baer, into an external layer, which forms its membranous envelopes, and an internal tubular portion, which afterwards becomes the proper nervous substance.

DEVELOPMENT OF THE SPINAL CORD.

Spinal cord: first a groove, then a tube.

The *spinal cord*, formed, as already stated, by the union of two lamellæ derived from the inner surface of the dorsal plates, is at first a groove open in its whole length on the dorsal aspect; but the edges of this groove soon meet, so as to form a medullary tube. At the ninth week Tiedemann * has seen the borders of this groove still apart; at the twelfth they were in close contact, so as to form a sort of tube, but they could be easily separated from one another. The perfect closing of this groove is delayed towards the lower end of the cord, which is slightly enlarged, and presents a longitudinal median slit, analogous to the rhomboidal sinus in birds.—Fig. 186, [9 9].

Central cavity is at length closed.

Grey matter.

The central cavity of the medullary tube formed by the closure of the groove is gradually narrowed by the thickening of the two halves of the cord and by the deposition of grey matter, and at last is obliterated in the human species throughout its entire length, except for about half an inch below the fourth ventricle. In many animals, however, it is persistent throughout life.

Anterior fissure of cord.

The *anterior fissure* of the cord is developed very early, and contains even at first a process of the pia mater.

Enlargements of cord.

The *cervical* and *lumbar enlargements* opposite the attachments of the brachial and crural nerves, appear at the end of the third month: in these situations the central canal, at that time not filled up, is somewhat larger than elsewhere.

Relative length of cord and canal. Cauda equina.

At first the cord occupies the whole length of the vertebral canal, so that there is no cauda equina. At the beginning of the fourth month, the vertebræ having grown faster than the cord, the latter seems as it were to have retired up into the canal, and the *cauda equina* is commenced. At the ninth month, the lower end of the cord is opposite the third lumbar vertebra.

DEVELOPMENT OF THE ENCEPHALON.

Primitive cephalic vesicles; three in number.

The three cephalic dilatations of the primitive cranio-vertebral cavity, fig. 186, B, [10], [11], [12], contain *three* hollow *vesicles* of nervous matter, which are the rudiments of the future encephalon.

The anterior or *first vesicle* soon becomes divided into an anterior and

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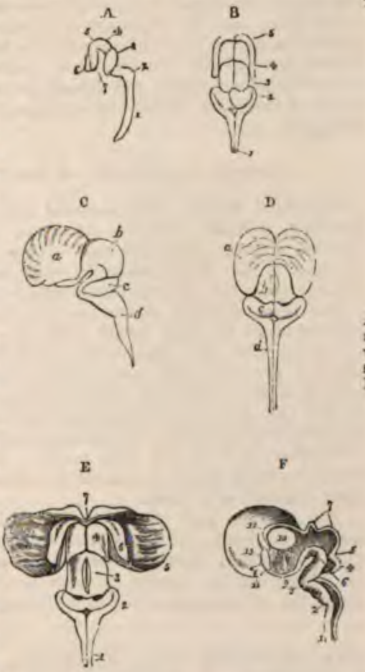
* To save the repetition of references, it may be stated here, that the description of the successive changes of development in the spinal cord and brain, and the periods at which they occur, are taken from Tiedemann's account. Anatomie und Bildungs-geschichte des Gehirns. Nürnberg, 1816.

a posterior portion. The anterior portion forms the principal mass of the hemispheres, fig. 187, A [6], with the corpora striata, [7]; whilst the posterior portion, [5], is developed into the thalami and third ventricle. First vesicle.

The *second* or middle vesicle, [4], forms the corpora quadrigemina above, and the crura cerebri below,—its cavity remaining as the Sylvian aqueduct. Second.

Fig. 187.*



The *third* or posterior vesicle, [3] to [2], continues incomplete above for some time, as far as nervous substance is concerned. At length its anterior portion, [3], is closed over and forms the cerebellum above, whilst on its under surface the pons Varolii appears. The posterior portion, on the other hand, [2], continues open on its dorsal aspect, and forms the medulla oblongata and fourth ventricle. Third.

These three vesicles, at first arranged in a straight line one before the other, soon alter their position, in correspondence with the curving downwards of the cephalic end of the embryo. Thus at the seventh week, as figured by Tiedemann, there is an angular bend forwards between the hindmost vesicle and the rudimentary spinal cord, [1],—the projecting angle (backwards) being named the cervical tuberosity, [2]. Another bend, but in the opposite direction, exists between that part of the third vesicle which forms the medulla oblongata, and that which gives rise to the cerebellum, [3]. Lastly, a third angle is produced by a bend forwards Arrangement of vesicles is soon angular.

* These figures show the early form of the brain and spinal cord in the human embryo (Tiedemann).—A. At the seventh week, viewed from the side. 1. Spinal cord. 2 to 3 is the third vesicle; 4, the middle vesicle; 5, 6, 7, the first or anterior vesicle. 2, is on the hind part of medulla, or the cervical tuberosity. 3. The cerebellum. 4. Corpora quadrigemina. 5. Optic thalami. 6. Cerebral hemisphere. 7. Corpus striatum.—B. At the ninth week, seen from behind. 1. Spinal cord, and medulla oblongata, open behind. 2. Cerebellum. 3. Corpora quadrigemina. 4. Thalami, still uncovered. 5. Right and left hemispheres, now very thin.—C, D. At the twelfth

and downwards in the region of the middle vesicle, [4], from which the corpora quadrigemina are developed, and which forms, at this period, the highest part of the encephalon; whilst the anterior or first vesicle, [5], [6], [7], is bent nearly at a right angle downwards.

Position of first vesicle.

At a later period of development, this first vesicle, which, as stated above, represents the cerebral hemispheres, increases greatly in size upwards and backwards, and gradually covers first the thalami; then the corpora quadrigemina, and lastly the cerebellum.

Rudiments of crura cerebri.

On laying open the rudimentary encephalon, two tracts of nervous matter are seen to be prolonged upwards from the spinal cord upon the floor of the cephalic vesicles: these tracts, which are doubtless connected with the anterior and lateral parts of the cord, are the rudiments of the *crura* cerebri and corresponding columns of the medulla oblongata.

FARTHER DEVELOPMENT OF THE PRIMARY VESICLES.

Third vesicle.

Formation of medulla oblongata and fourth ventricle.

The *third vesicle*.—The posterior portion of this vesicle, corresponding with the *medulla oblongata*, is never closed above by nervous matter. The open part of the medullary tube constitutes the floor of the *fourth ventricle*, which communicates below with the canal of the spinal cord, and eventually forms the calamus scriptorius.

Restiform bodies.

Anterior pyramids.

Olivary bundles and tubercle.

Fasciolæ cinereæ and striæ.

The three elements of the medulla oblongata begin to be distinguished about the third month; first, the *restiform* bodies which are connected with the commencing cerebellum, and afterwards the anterior pyramids and olives. The *anterior pyramids* become prominent on the surface and distinctly defined in the fifth month; and by this time also their decussation is evident. The *olivary* fasciculi are early distinguishable, but the proper *olivary body*, or tubercle, does not appear till about the sixth month. The *fasciolæ cinereæ* of the fourth ventricle can be seen at the fourth or fifth month, but the *white striæ* not until after birth.

Formation of cerebellum.

The anterior part of the third vesicle is soon closed above by nervous substance, and forms the commencing *cerebellum*, A, [3]. This part exists, B, [2], about the end of the second month, as a delicate medullary lamina, forming an arch behind the corpora quadrigemina across the widely-open primitive medullary tube.

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week, side and back views. *a.* Cerebrum. *b.* Corpora quadrigemina. *c.* Cerebellum. *d.* Medulla oblongata. N.B. The thalami at this period are covered by the cerebral hemispheres.—E, F. At the twelfth week: in E, which is seen from behind, the hemispheres are reflected outwards. 1. Cord and medulla oblongata. 2. Cerebellum. 3. Corpora quadrigemina. 4. Thalami, which are here uncovered by the reflection of the hemispheres. 5, 6. The right corpus striatum, embedded in the hemisphere. 7. The point of commencement of corpus callosum. F, is a vertical median section, showing the cavity from the cord up to the third ventricle. 1, 2. Spinal cord and medulla, still hollow. 3. Bend at which pons Varolii is to be formed. 4. Cerebellum. 5. Lamina (superior peduncles) leading up to corpora quadrigemina. 6. Crura cerebri. 7. Corpora quadrigemina. 8. Third ventricle. 9. Infundibulum. 10. Thalamus, now solid. 11. Optic nerves. 12. Cleft leading into lateral ventricle. 13. Commencing corpus callosum.

According to Bischoff, the cerebellum does not commence by two lateral plates which grow up and meet each other in the middle line; but a continuous deposit of nervous substance takes place across this part of the medullary tube, and closes it in at once. This layer of nervous matter, which is soon connected with the corpora restiformia, or inferior peduncles, increases gradually up to the fourth month (see C, D, c, also E, [2]), at which time there may be seen on its under surface the commencing *corpus dentatum:* in the fifth month a division into five *lobes* has taken place; at the sixth, these lobes send out *folia*, which are at first simple, but afterwards become subdivided. Moreover, the *hemispheres* of the cerebellum are now relatively larger than its median portion, or *worm*. In the seventh month the organ is more complete, and the *flocculus* and *posterior velum*, with the other parts of the inferior vermiform process, are now distinguishable, except the *amygdalæ*, which are later in their appearance.

Corpus dentatum. Lobes, folia, hemispheres, and other divisions.

Of the *peduncles* of the cerebellum, the *inferior* pair (corpora restiformia) are the first seen—viz., about the third month; the *middle* peduncles are perceptible in the fourth month; and at the fifth, the *superior* peduncles and the Vieussenian valve, F [5]. The *pons Varolii* is formed, as it were, by the fibres from the hemispheres of the cerebellum, embracing the pyramidal and olivary fasciculi of the medulla oblongata. According to Baer, the bend which takes place at this part of the encephalon—just over [7], A, also at [3], F—thrusts down a mass of nervous substance before any fibres can be seen; and in this substance transverse fibres, continuous with those of the cerebellum, are afterwards developed. From its relation to the cerebellar hemispheres the pons keeps pace with them in its growth; and, in conformity with this, its transverse fibres are few, or entirely wanting, in those animals in which there is a corresponding deficiency or absence of the lateral parts of the cerebellum.

Peduncles. Formation of pons.

The *second or middle vesicle.*—The *corpora quadrigemina*—A, [4], B and E, [3]; C and D, *b*—are formed in the upper part of the middle cephalic vesicle, A, [4]; the hollow in the interior of which, shown in D, communicates with those of the first and third vesicles. The corpora quadrigemina, in the early condition of the human embryo, are of great proportionate volume, in harmony with what is seen in the lower vertebrata, but subsequently they do not grow so fast as the anterior parts of the encephalon, and are therefore soon reached by the cerebral hemispheres, which at the sixth month cover them in completely. Moreover, they become gradually solid, by the deposition of matter within them; and as, in the meantime, the *cerebral peduncles*, D, [6], are growing rapidly in size in the floor of this second cephalic vesicle, the cavity in its interior is quickly filled up, with the exception of the narrow passage named the *Sylvian aqueduct*. The fillet is distinguishable in the fourth month. The corpora quadrigemina of the two sides are not marked off from each other by a vertical median groove until about the sixth month; and the transverse depression separating the anterior and posterior pairs is first seen about the seventh month of intra-uterine life.

Second vesicle. Formation of corpora quadrigemina. Cerebral peduncles, and Sylvian aqueduct.

The *first* or anterior *vesicle*, A, [5], [6], [7].—This vesicle, as already stated, is divided into two portions—viz. a posterior, which is developed into the optic thalami and third ventricle, and an anterior, which forms the principal mass of the cerebral hemispheres, including the corpora striata.

First vesicle. Posterior portion.

a. The two *optic thalami*—A, [5], B and C, [4]—consist, therefore, at

Formation

on each side, and their enlarged extremity appears then to constitute the commencing *pes hippocampi*, the indentations upon which, however, are not evident until the ninth month. The *hippocampus minor* appears at the end of the fourth month, as a folding inwards of the hemisphere into the ventricular cavity.

Pes major and pes minor.

In the course of development, the fore part of the fornix separates from the under surface of the corpus callosum, leaving two thin vertical lamellæ, which form the *septum lucidum*, and the intermediate fifth ventricle. At first, this ventricle communicates with the cavity of the third ventricle below, but it is afterwards completely occluded by the union of the two lamellæ. The septum and fifth ventricle are recognised only about the fifth month.

Septum lucidum, and fifth ventricle.

Formation of lateral ventricles;

In the first instance, the vesicular cerebral hemispheres enclose a common cavity; but as the median longitudinal depression is formed between them, as the corpus callosum and fornix are developed from before backwards, and as the septum lucidum descends from one to the other in the median plane, this single cavity is divided into the two *lateral ventricles*, which after a time communicate with each other, and with the third ventricle, by a narrow slit, F, 12; and, finally, only by the foramen of Monro. The form of each ventricular cavity depends upon that of the several parts which project into it. Thus its *anterior cornu* is produced around the anterior extremity of the corpus striatum, and its *descending cornu* behind the thalamus and below the striated body. The *posterior cornu* is later in its appearance, and is developed in the substance of the posterior lobe, as that extends itself backwards. The lateral ventricles, or rather the parts of which their walls are composed, do not acquire their characteristic forms until the eighth or ninth month.

their cornua.

GREY AND WHITE SUBSTANCE OF THE NERVOUS CENTRES.

Distinction of grey and white matter.

The distinction between the grey and white substances is not at first to be made out; but there is no evidence to show that one precedes the other in its formation. Valentin states that he has distinguished the one from the other at the third month; less from the difference in their colour than from their microscopic characters.

MEMBRANES OF THE ENCEPHALON.

Formation of membranes. Pia mater.

It is remarked by Bischoff, that the membranes of the brain are everywhere formed by the separation of the outer layer of the primitive cephalic mass; and thus, that the *pia mater* does not send inwards processes into the fissures or sulci, or into the ventricular cavities; but that every part of this vascular membrane, including the *choroid plexuses* and *velum interpositum*, is formed in its proper position upon the nervous matter.

Dura mater.

The pia mater and dura mater have both been detected about the seventh or eighth week, at which period the tentorium cerebelli existed. At the third month the falx cerebri, with the longitudinal and lateral sinuses, could be made out; and the choroid plexuses of both the lateral and fourth ventricles were distinguishable. No trace of arachnoid, however, could be seen until the fifth month.

Arachnoid.

CRANIAL NERVES.

ALL nerves issuing from the cerebro-spinal centre, which are transmitted through apertures in the base of the skull are included in the class of *cranial nerves*. Definition.

These nerves are named numerically, according to the relative position of the apertures for their transmission through the cranium; and they are likewise distinguished by other names, taken from the organs or parts to which they are distributed—*e. g.* facial, glosso-pharyngeal; or from the functions to which they minister, viz. olfactory, optic, &c. Nomenclature of the nerves.

The number of the cranial nerves is differently stated by anatomists. The difference is mainly owing to the circumstance that, under one system, the nerves which enter the internal auditory meatus, and those which pass through the jugular foramen, are in each case considered a single pair (seventh and eighth) divisible into parts; while under another system each of the nerves is numbered separately. The classifications exemplifying the two modes of numbering—those of Willis and Sömmerring—are subjoined:— Difference as to number recognised.

Classification of Willis and Sömmerring:

WILLIS.		SÖMMERRING.	
First pair of nerves,	Olfactory nerves.	The first six names are the same as those of Willis.	
Second ,,	Optic.		
Third ,,	Oculo-motor.		
Fourth ,,	Pathetic.		
Fifth ,,	Trifacial or trigeminal.		
Sixth ,,	Abducent-ocular.		
Seventh { nervus durus,	Facial.	Seventh pair of nerves,	Facial nerves.
Seventh { n. mollis,	Auditory.	Eighth ,,	Auditory.
Eighth { n. vagus,*	Pneumo-gastric.	Ninth ,,	Glosso-pharyngeal.
Eighth { n. accessorius,	Spinal accessory.	Tenth ,,	Pneumogastric.
Ninth ,,	Lingual or hypoglossal.	Eleventh ,,	Spinal accessory.
Tenth ,,	Sub-occipital.	Twelfth ,,	Lingual or hypoglossal.

* Willis described the glosso-pharyngeal nerve as a branch of the vagus.

the latter the best.

The arrangement of Sömmerring is the preferable one, as being the simplest and most natural; for each of the parts included in the seventh and eighth pairs of Willis is really a distinct nerve. But as the plan of Willis is in general use, it will most conveniently be followed here: with the exception, however, that the tenth pair (sub-occipital) of that anatomist will be ranged with the spinal nerves. The cranial nerves will therefore be regarded as consisting of nine pairs.

OLFACTORY NERVE.

First cranial nerve.

The olfactory or first cranial nerve (nervus olfactorius, par primum), the special nerve of the sense of smelling, is distributed exclusively to the nasal fossæ. The course of this nerve within the cranium has been already described (page 513). It remains to add an account of the branches distributed in the interior of the nose.

Branches from olfactory bulb,

From the under surface of the olfactory bulb, fig. 192,[1], about twenty branches proceed through the holes in the cribriform plate of the ethmoid bone, each being invested by tubular prolongations of the membranes of the brain.

and their coverings.

These tubes of membrane vary in the extent to which they are continued on the branches. Thus the offsets of the dura mater sheathe the filaments, and join the periosteum lining the nose; those of the pia mater become blended with the neurilemma of the nerves; and those of the arachnoid re-ascend to the serous lining of the skull.

Distribution of filaments in nasal fossa.

The branches are arranged in three sets. The inner set, lodged for awhile in grooves on the surface of the bone, ramify in the pituitary membrane of the septum; the outer set, fig. 192, extend to the upper two spongy bones, and the plane surface of the ethmoid bone in front of these; and the middle set, which are very short, are confined to the roof of the nose. The distribution of the olfactory nerve is confined to the upper part of the nasal fossa; none of the branches reach the lower spongy bone.—(See Anatomy of the Nose.)

OPTIC NERVE.

Second nerve.

The optic or second cranial nerve (nervus opticus, par secundum), a nerve of special sense, belongs exclusively to the eye. The connection of this nerve with the encephalon,

the optic tract, and the commissure of the nerves of opposite sides, have been described at a former part of this volume (page 514.)

Course in orbit.

From the commissure at the base of the brain, each nerve diverging from its fellow, becomes round and firm, and is incased in a neurilemma. In the orbit, which it enters by the optic foramen, it is invested with a sheath of the dura mater, and surrounded by the recti muscles; and finally, after piercing successively the sclerotic and choroid coats at the back of the eyeball, it expands into the retina.—(See the Anatomy of the Eye.)

Ends in retina.

THIRD PAIR OF NERVES.

Third cranial nerve.

This nerve, the common motor nerve of the eyeball (nerv. motorius oculi, par tertium), fig. 188,[4], gives branches to five of the seven muscles of the orbit.

Like the other motor nerves, the third is round, firm, and white; it is invested from the first by a sheath of pia mater, and afterwards by a tube of the arachnoid membrane.

Course at base of skull.

In its course to the orbit, this nerve is contained in the external fibrous boundary of the cavernous sinus with other nerves: and on entering the canal appropriated to it in the dura mater, the serous covering of the arachnoid is reflected from it.*

Divides into two parts.

After receiving one or two delicate filaments from the cavernous plexus of the sympathetic, the third nerve divides near the orbit into two parts, which are continued into that cavity between the heads of the external rectus muscle.

Upper portion.

The *upper*, the smaller part, fig. 188, is directed inwards over the optic nerve to the superior rectus muscle of the eye, and the elevator of the eyelid, to both which muscles it furnishes offsets.

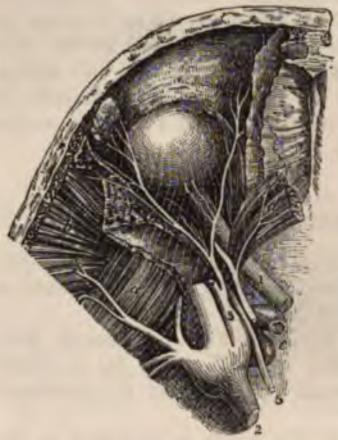
Lower portion.

The *lower* and larger portion of the nerve, fig. 191, separates into three branches;—of which one reaches the inner rectus; another the lower rectus; and the third, the longest of the three, runs onwards between the lower and the outer rectus, and terminates below the ball of the eye

* For an account of the relative position of the orbital nerves before they enter the orbit, see the statement placed after the description of this (the third) nerve.

in the inferior oblique muscle. The last-mentioned branch is connected with the lower part of the lenticular ganglion by a short thick cord, and gives two filaments to the lower rectus muscle.

Fig. 188.*



How nerves enter the muscles.

The several branches of the third nerve enter the muscles, to which they are distributed on that surface of the muscle, in each case, which looks towards the eyeball.

Position of certain nerves at the cavernous sinus, and as they enter the orbit.—As several nerves are placed close together at the cavernous sinus, and as they enter the orbit through the same foramen, a statement will now be made, once for all, respecting the position they bear to each other, in order to save the repetition which otherwise would be necessary when each of the nerves in question is under consideration.

Order of nerves at cavernous sinus;

At the cavernous sinus.—In the dura mater which bounds the cavernous sinus on the outer side, the third and fourth nerves, and the ophthalmic division of the fifth, are placed, as regards one another, in their numerical order both from above downwards and from within outwards. The sixth nerve is close to the carotid artery—not in the wall of the sinus. Near the sphenoidal fissure, through which they enter the orbit, the relative position of the nerves is changed, and their number is augmented, the sixth nerve being here close to the rest, and both the third and ophthalmic

* The deep nerves of the orbit seen from above by removing the bone and dividing the elevator of the upper eyelid and the upper rectus muscle. (From Arnold.) *a.* Internal pterygoid muscle. *b.* Temporal muscle. *c.* Cut surface of bone. *d.* Elevator of the eyelid and upper rectus muscle. *e.* Carotid artery. 1. Optic nerve. 2. Fifth nerve. 3. Ophthalmic nerve. 4. Third nerve. 5. Sixth nerve.

nerves being divided—the former into two, the latter into three parts.

In the sphenoidal fissure.—The fourth, and the frontal and lachrymal branches of the fifth, which are here higher than the rest, lie on the same level, the first-named being the nearest to the inner side; and these nerves enter the orbit above the muscles, fig. 189. In entering the same cavity, the remaining nerves pass between the heads of the outer rectus muscle, with the following relative position to each other: the upper division of the third, which is highest, the nasal branch of the fifth next, the lower division of the third beneath these, and the sixth below all. In entering the orbit.

FOURTH PAIR OF NERVES.

The fourth (pathetic nerve, nervus trochlearis, n. patheticus, par quartum), fig. 189,[4], is the smallest of the cranial nerves, and is distributed only to the upper oblique muscle of the orbit.* Fourth nerve.

From the remoteness of its place of origin, (see p. 515,) this nerve has a longer extent in the skull than any other cranial nerve. It has the same general course as the third in the wall of the cavernous sinus and through the sphenoidal fissure. Before reaching the sinus it is on a level with the margin of the tentorium cerebelli, by the side of the pons Varolii; and it enters an aperture in the free border of the tentorium, outside that for the third nerve, and near the posterior clinoid process. Continuing onwards through the outer wall of the cavernous sinus, the fourth nerve enters the orbit by the sphenoidal fissure, and above the muscles. Its position with reference to other nerves in this part of its course has been already referred to above. Length in skull. Course.

While in its fibrous canal in the outer wall of the sinus, the fourth nerve is joined by filaments of the sympathetic, and not unfrequently is blended with the ophthalmic division of the fifth. Bidder states that some offsets are here given from it to the dura mater.† Connections.

* This nerve receives its name from entering the dura mater in the base of the skull, next to the third.

† Three or more small filaments are described as extending in the tentorium as far as the lateral sinus, and one is figured as joining the sympathetic on the carotid artery.—Neurologische Beobachtungen, Von Dr. F. H. Bidder. Dorpat. 1836.

Distribution. In the orbit, fig. 189,[4], the fourth nerve inclines inwards above the muscles, and enters finally the orbital surface of the upper oblique muscle.

FIFTH PAIR OF NERVES.

Functions of this nerve. The fifth, or trifacial nerve (nerv. trigeminus, nerf trifacial, par quintum), fig. 190, the largest cranial nerve, is somewhat analogous to the spinal nerves. It is a nerve of special sense (taste), and it imparts common sensibility (the sense of touch) to the face and the fore part of the head, as well as to the eye, the nose, the ear, and the mouth. This nerve moreover supplies motor nerves to the muscles of mastication.

Fig. 189.*

Course of the roots in the skull. The roots of the fifth nerve, after emerging from the surface of the encephalon (p. 516), are directed forwards, side by side, to the middle fossa of the skull, through an aperture in the dura mater on the summit of the petrous part of the temporal bone. Here the larger root alters in appearance: its fibres diverge a little, and enter a semilunar body,—the Gasserian ganglion. The smaller root passes beneath the ganglion, without being united in any way to it, and joins outside the skull the lowest of the three trunks which issue from the ganglion.

Gasserian ganglion. The *ganglion of the fifth nerve* or *Gasserian ganglion* (ganglion semilunare seu Gasserianum) occupies a depression on the upper part of the petrous portion of the temporal bone, near the point, and is crescentic in form, the convexity being turned forwards. On its inner side the ganglion is joined

* The nerves in the orbit above the muscles, brought into view by removing the roof of the orbit and the periosteum (Arnold). 1. Fifth nerve. 2. Ophthalmic branch of same nerve. 3. Third nerve. 4. Fourth nerve. 5. Optic nerve. 6. Sixth nerve. *a*. Internal carotid artery.

by filaments from the carotid plexus of the sympathetic nerve, and, according to some anatomists, it furnishes from its back part filaments to the dura mater.

From the fore part, or convex border of the Gasserian ganglion, proceed three large branches. Trunks of fifth nerve;

Fig. 190.*

ganglion, proceed three large branches. The highest (first or ophthalmic trunk) enters the orbit; the second, the upper maxillary nerve, is continued forwards to the face, below the orbit; and the third, the lower maxillary nerve, is distributed chiefly to the ear, the tongue, the lower teeth, and the muscles of mastication. The first two trunks of outline of their arrangement. Two, sensory.

* A plan of the branches of the fifth nerve, modified from a sketch by Sir C. Bell. *a*. Submaxillary gland, with the submaxillary ganglion above it. 1. Small root of the fifth nerve, which joins the lower maxillary trunk. 2. Larger root, with the Gasserian ganglion. 3. Ophthalmic nerve. 4. Upper maxillary nerve. 5. Lower maxillary nerve. 6. Chorda tympani. 7. Facial nerve.

the nerve proceeding from the ganglion, confer sensibility on the structures in which they ramify; but the last, in addition to that function, gives motor power to the muscles referred to,—this additional function being derived from the smaller root which joins this part of the nerve. The inferior maxillary is therefore a compound nerve, for in it are combined motor and sensory fibres. This last part of the fifth cranial nerve resembles a spinal nerve; but with the difference that, while all the offsets of a spinal nerve partake of both motor and sensory fibres, only a portion of the lower maxillary nerve is so compounded, the motor root being joined, as already stated, with but a part of the fibres emanating from the ganglion.

One, compound nerve.

How far resembles a spinal nerve.

OPHTHALMIC NERVE.

Ophthalmic trunk.

The ophthalmic nerve, or first trunk of the fifth nerve, (ramus quinti paris primus vel ophthalmicus,) fig. 190,[3], is the smallest of the three offsets from the Gasserian ganglion. It is a flat fasciculus, about an inch in length, and is directed upwards to the sphenoidal fissure, where it ends in branches which continue onwards through the orbit to the surface of the head. In the skull this portion of the fifth nerve is contained in the process of the dura mater bounding externally the cavernous sinus, and it is here joined by filaments from the cavernous plexus of the sympathetic; according to Arnold, it gives recurrent branches to the tentorium cerebelli.* The fourth nerve frequently communicates by a considerable branch with this nerve.

Course in skull.

Connection with sympathetic.

Branches.

Near the orbit the ophthalmic nerve furnishes from its inner side the nasal branch, and then divides into the frontal and lachrymal branches. These offsets are transmitted separately through the sphenoidal fissure, and are continued through the orbit (after supplying some filaments to the eye and the lachrymal gland) to the nose, the eyelids, and the muscles and integument of the forehead.

* There is as much difference of statement among modern as among ancient authorities respecting nerves to the dura mater. Bidder delineates branches furnished to this membrane from the fourth nerve. Arnold represents the nerves as coming from the ophthalmic trunk of the fifth. Purkinje supposes them to be derived from filaments of the sympathetic nerve that run along the meningeal arteries; and Valentin states that they emanate from the sympathetic on the carotid artery. Mr. Swan says that the sixth nerve "sends several filaments to the dura mater behind the Gasserian ganglion."

LACHRYMAL BRANCH.

Lachrymal branch. **Position in the orbit.** **Offsets.** **Communications.**

The lachrymal branch, fig. 189, is external to the frontal at its origin, and is contained in a separate tube of dura mater. In the orbit it courses along the outer part, above the muscles, to the outer angle of the cavity. When near the lachrymal gland, the nerve has a connecting filament with the orbital branch of the upper maxillary nerve ; and when lying in close apposition with the gland, it gives many filaments to this and to the conjunctiva. Finally, the lachrymal nerve penetrates the palpebral ligament, and ends in the upper eyelid, the terminal ramifications being joined by the facial nerve.*

FRONTAL BRANCH.

Position in the orbit. **Division.**

The frontal branch, fig. 189,[2], the largest offset of the ophthalmic, lies, like the preceding nerve, above the muscles in the orbit, and occupies the middle of the cavity, being between the elevator of the upper eyelid and the periosteum. About midway between the base and summit of the orbit, the nerve divides into branches (supra-trochlear and supra-orbital), which, after emerging at the fore part of the orbit, supply the muscles and integument of the forehead and the upper eyelid.

Supra-trochlear branch.

The internal or *supratrochlear branch*, fig. 189, is prolonged to the point at which the pulley of the upper oblique muscle is fixed to the orbit. Here it gives downwards a filament to connect it with the infratrochlear branch of the nasal nerve, and issues from the cavity between the orbicular muscle of the lids and the bone. In this last position filaments are distributed to the upper eyelid. The nerve next pierces the orbicularis palpebrarum and occipito-frontalis muscles, furnishing offsets to these muscles and the corrugator supercilii and, after ascending on the forehead, ramifies in the integument.

Supra-orbital branch

The external or *supraorbital branch*, fig. 190, passes through the notch of the same name to the forehead, and

* In consequence of the junction which occurs between the ophthalmic trunk of the fifth and the fourth nerve, the lachrymal branch sometimes appears to be derived from both. Mr. Swan considers this the usual condition of the lachrymal nerve.—A Demonstration of the Nerves of the Human Body, page 36. London, 1834.

ends in muscular, cutaneous, and pericranial branches; while in the notch this nerve distributes *palpebral* filaments to the upper eyelid.

palpebral;

muscular;

The *muscular branches* referred to, supply the corrugator of the eyebrow, the occipito-frontalis, and the orbicular muscle of the eyelids, and join the facial nerve in the last muscle. The *cutaneous nerves*, among which two (outer and inner) may be noticed as the principal branches, are placed at first beneath the occipito-frontalis. The outer one, the larger, perforates the tendinous expansion of the muscle, and ramifies in the scalp as far back as the lambdoidal suture. The inner branch reaches the surface sooner than the preceding nerve, and ends in the integument over the parietal bone. The *pericranial branches* arise from the cutaneous nerves beneath the muscle, and end in the pericranium covering the frontal and parietal bones.

cutaneous;

and pericranial offsets.

NASAL BRANCH.

Nasal branch.

The nasal branch (r. oculo-nasalis), fig. 190, which is more deeply placed than either of the other branches of the ophthalmic nerve, occupies a place successively in the cavities of the orbit, the cranium, and the nose. In its circuitous course this nerve has many and varied connections.

Origin, and course in orbit.

Separating from its parent trunk in the wall of the cavernous sinus, the nasal nerve enters the orbit between the heads of the outer rectus. Within the orbit it inclines inwards over the optic nerve, beneath the elevator of the upper eyelid and the upper rectus muscle, to the inner wall of the cavity. In this oblique course across the orbit it furnishes a single filament to the lenticular ganglion, and two or three (ciliary) directly to the eyeball; and at the inner side of the cavity it gives off a considerable branch (infratrochlear), which leaves the orbit at the fore part. After furnishing these offsets, the nasal nerve enters the anterior of the two foramina in the inner wall of the orbit, and passing above the ethmoidal cells, appears for a short space in the cranium. Within the skull the nerve lies in a groove on the edge of the cranial surface of the ethmoid bone, by which it is conducted to a special aperture at the fore part of the cribriform plate. By that opening it is transmitted to the roof of the nasal fossa, where it ends in two branches, one of which (external nasal) reaches the

Course in base of the skull;

integument of the side of the nose, and the other (internal nasal) ramifies in the pituitary membrane. The *branches* which have been indicated as furnished by the nasal nerve, will be now referred to in detail. reaches the nose. Branches:

The *branch to the lenticular ganglion* (radix longa ganglii ciliaris), fig. 191, very slender, and about half an inch long, arises generally between the heads of the rectus. This small branch is sometimes joined by a filament from the cavernous plexus of the sympathetic, or from the upper branch of the third nerve; it lies on the outer side of the optic nerve, and enters the upper and back part of the lenticular ganglion, constituting its long root. in orbit: one to lenticular ganglion.

The *long ciliary nerves*, fig. 191, two or three in number, are situate on the inner side of the optic nerve; they join one or more of the nerves from the lenticular ganglion, (short ciliary,) and after perforating the sclerotic coat of the eye, are continued between it and the choroid to the ciliary muscle, the cornea, and the iris. Long ciliary: end in iris.

The *infratrochlear branch*, fig. 190, runs forwards along the inner side of the orbit below the upper oblique muscle, and receives near the pulley of that muscle a filament of connection from the supratrochlear nerve. The branch is then continued below the pulley (whence its name) to the inner angle of the eye, and ends in filaments which supply the orbicular muscle of the lids, the caruncula, and the lachrymal sac, as well as the integument of the eyelids and side of the nose. Infratrochlear.

In the cavity of the nose the nasal nerve ends by dividing into the following branches:— Branches to nose.

The *branch to the nasal septum* (ramus septi) extends to the lower part of the partition between the nasal fossæ, supplying the pituitary membrane near the fore part of the septum. Branch to septum.

The *external branch* (r. externus seu lateralis), fig. 192, [2], descends in a groove on the inner surface of the nasal bone: and after leaving the nasal cavity between that bone and the lateral cartilage of the nose, fig. 190, it is directed downwards to the tip of the nose, beneath the compressor naris muscle. While within the nasal fossa, this branch gives two or three filaments to the fore part of its outer wall, which extend as far as the lower spongy bone. The cutaneous part joins the facial nerve. Cutaneous branch.

Summary.—The first division of the fifth nerve is altogether sensory in function. It furnishes branches to Summary of ophthalmic.

the ball of the eye and the lachrymal gland; to the mucous membrane of the nose and eyelids; to the integument of the nose and the fore part of the head; and to the muscles above the upper half of the circumference of the orbit. Some of the cutaneous filaments join offsets of the facial nerve, and the nerve itself communicates with the sympathetic.

OPHTHALMIC GANGLION.

Ganglia connected with the divisions of fifth nerve.

There are four small ganglionic masses connected with the trunks of the fifth nerve: the ophthalmic ganglion with the first trunk, Meckel's ganglion with the second, and the otic and submaxillary ganglia with the third trunk of the nerve. These several bodies receive sensory nerves from the fifth, motor nerves from other sources, and twigs from the sympathetic; and the nerves thus joining the ganglia are named their roots.

Ophthalmic ganglion. Its nature. Position. Form. Roots and branches.

The *ophthalmic* or *lenticular* ganglion (gang. ophthalmicum, semilunare, vel ciliare), fig. 191, serves as a centre for the supply of nerves—motor, sensory, and sympathetic—to the eyeball. It is a small reddish body, situate at the back of the orbit, between the outer rectus muscle and the optic nerve, and generally in contact with the ophthalmic artery. Rounded, or somewhat quadrangular in shape, it is joined behind by offsets from the fifth, the third, and the sympathetic nerves; and from its fore part proceed ciliary nerves to the eyeball.—From the quantity of fat surrounding the ganglion, it is not always easy to detect it.

Long root. Short root. Sympathetic filament.

Union of the ganglion with nerves: its roots.—The border of the ganglion directed backwards receives three nerves. One of these, the *long root*, fig. 191, from the nasal branch of the ophthalmic trunk, joins the upper part (upper angle) of this border. Another branch, the *short root*, fig. 191, thicker and much shorter than the preceding, and sometimes divided into parts, is derived from the branch of the third nerve supplied to the lower oblique muscle, and is connected with the lower part (lower angle) of the ganglion. The *third* small *nerve*, fig. 191, emanates from the cavernous plexus of the sympathetic, and reaches the ganglion with the long upper root; or these two nerves may be inseparably conjoined before reaching the ganglion.*

* Other roots have been assigned to the ganglion. See a paper by Valentin in Müller's Archiv. for 1840.

Branches of the ganglion.—From the fore part of the ganglion arise ten or twelve delicate filaments—the *short* Branches.

Fig. 191.*

ciliary nerves, fig. 191. These nerves are disposed in two fasciculi, arising from the upper and lower angles of the ganglion, and they run forwards, one set above, the other below the optic nerve, the latter being the more numerous. They are accompanied by filaments from the nasal nerve (long ciliary), with which some are joined. Having entered the eyeball by apertures in the back part of the sclerotic coat, the nerves are lodged in grooves on its inner surface; and at the ciliary muscle, which they pierce, (some offsets supplying it and the cornea) they turn inwards and ramify in the iris. Short ciliary nerves: they end in iris.

UPPER MAXILLARY NERVE.

The upper maxillary nerve, or second division of the fifth cranial nerve (ramus quinti paris secundus, v. maxil- Second trunk of the fifth.

* A representation of some of the nerves of the orbit, especially to show the lenticular ganglion (Arnold). 1. Ganglion of the fifth. 2. Ophthalmic nerve. 3. Upper maxillary. 4. Lower maxillary. 5. Nasal branch, giving the *long root* to the lenticular ganglion. 6. Third nerve. 7. Inferior oblique branch of the third connected with the ganglion by the *short root*. 8. Optic nerve. 9. Sixth nerve. 10. Sympathetic on the carotid artery.

laris superior), fig. 190, [4], is intermediate in size and situation beween the ophthalmic and lower maxillary trunks.

This nerve, named from its connection with the upper maxilla, has an almost horizontal direction, in great part through that bone, to the face. It commences at the middle of the Gasserian ganglion, presenting at its origin the appearance of a flattened band, and speedily leaves the skull by the foramen rotundum of the sphenoid bone, having previously become round and firm. After escaping from the cavity of the skull the nerve crosses the spheno-maxillary fossa, and enters the canal in the floor of the orbit (in the orbital plate of the upper maxilla), by which it is conducted to the face. As soon as it emerges from the infraorbital foramen, the upper maxillary nerve terminates beneath the elevator of the upper lip in branches which spread out to the side of the nose, the eyelid, and the upper lip.

Commencement.

Course in skull;

outside the skull.

Branches.—In the spheno-maxillary fossa a branch ascends from the upper maxillary nerve to the orbit, and one or two descend to join Meckel's ganglion, and to be distributed to the nose and mouth. Whilst the nerve is in contact with the upper maxilla, it furnishes dental branches—one on the tuberosity of the bone, the other at the fore part. To these must be added the terminal branches already indicated.

Branches: outline of.

ORBITAL BRANCH.

The orbital or temporo-malar branch, a small cutaneous nerve, enters the orbit by the spheno-maxillary fissure, and divides into two branches (temporal and malar), which are distributed, as their names imply, to the temple and the prominent part of the cheek.

Orbital branch divides into

The *temporal branch* is contained in an osseous groove or canal in the outer wall of the orbit, and leaves this cavity by a foramen in the malar bone. When about to traverse the bone, it is joined by a communicating filament, (in some cases, two filaments,) from the lachrymal nerve. The nerve is then inclined upwards in the temporal fossa between the bone and the temporal muscle, perforates the aponeurosis over the muscle an inch above the zygoma, and ends in cutaneous filaments over the temple. The cutaneous ramifications are united with the facial nerve, and sometimes with the superficial temporal nerve of the third division of the fifth.

a temporal branch,

The *malar branch* (r. subcutaneus malæ), lies at first in the loose fat in the lower angle of the orbit, and is continued to the face through a foramen in the malar bone, where it is frequently divided into two filaments. In the prominence of the cheek this nerve communicates with the facial nerve. and a malar branch.

SPHENO-PALATINE BRANCHES.

The spheno-palatine branches, fig. 190, two in number, descending from the trunk of the nerve in the spheno-maxillary fossa, are connected with the ganglionic body (Meckel's ganglion), which is placed in that fossa, and are distributed to the nose and palate. These branches will be described with the ganglion referred to.—See p. 550. Spheno-palatine branches.

POSTERIOR DENTAL BRANCHES.

The posterior dental branches, fig. 190, two in number, are directed outwards over the tuberosity of the maxillary bone. Posterior dental: two branches.

One of the branches enters a canal in the bone by which it is conducted to the teeth, and gives forwards a communicating filament to the anterior dental nerve. It ends in filaments to the molar teeth and the lining membrane of the cavity in the upper maxillary bone, and near the teeth joins a second time with the anterior dental nerve. Posterior of the two;

The *anterior* of the two branches, lying on the surface of the bone, is distributed to the gums of the upper jaw and to the buccinator muscle. anterior.

ANTERIOR DENTAL BRANCH.

The anterior dental branch, leaving the trunk of the nerve at a varying distance from its exit at the infraorbital foramen, enters a special canal in front of the antrum of Highmore. In this canal it receives the filament from the posterior dental nerve, and divides into two branches, which furnish offsets for the front teeth. Anterior dental. two branches.

One branch, the *inner* one, supplies the incisor and canine teeth. Filaments from this nerve enter the lower meatus of the nose, and end in the membrane covering the lower spongy bone. Inner branch.

Outer. The *outer* branch gives filaments to the bicuspid teeth, and is connected with the posterior dental nerve.

INFRAORBITAL BRANCHES.

The infraorbital branches, fig. 190, which are large and numerous, spring from the end of the upper maxillary nerve beneath the elevator muscle of the upper lip, and are divisible into palpebral, nasal, and labial sets.

Branch to eyelid; The *palpebral branch* (there may be two branches) turns upwards to the lower eyelid in a groove or canal in the bone, and supplies the orbicular muscle; it ends in filaments which are distributed to the lid in its entire breadth. At the outer angle of the eyelids this nerve is connected with the facial nerve.

to side of the nose; The *nasal branches* are directed inwards to the muscles and integument of the side of the nose, and they communicate with the cutaneous branch of the nasal nerve furnished by the ophthalmic trunk of the fifth nerve.

to the upper lip. The *labial*, the largest of the terminal branches of the upper maxillary nerve, and three or four in number, are continued downwards beneath the proper elevator of the upper lip. Branching as they descend, these nerves are distributed to the integument, the mucous membrane of the mouth, the labial glands, and the muscles of the upper lip.

Union with facial nerve. Near the orbit the infraorbital branches of the upper maxillary nerve are joined by branches of the facial nerve, the union between the two being named *infraorbital plexus*.

SPHENO-PALATINE GANGLION.

Situation. The spheno-palatine ganglion, commonly named Meckel's ganglion, fig. 192, has its seat on the spheno-palatine branches of the upper maxillary nerve, and is deeply placed in a hollow (spheno-maxillary fossa) between the pterygoid process of the sphenoid bone and the upper maxilla, and close to the spheno-palatine foramen. It is of a greyish

[illegible] colour, triangular in form or heart-shaped, and convex on the outer surface. The grey or ganglionic substance is not

[illegible] mixed with all the fibres of the spheno-palatine branches of the upper maxillary nerve, but is placed at the back part, at the point of junction of the sympathetic or deep branch

of the Vidian, so that the spheno-palatine nerves proceeding to the nose and palate pass to their destination without being involved in the usual way in the ganglionic mass.

Fig. 192.*

Branches.

Considering the ganglion as a centre from which offsets proceed,—there are branches from it directed upwards to the orbit, some downwards to the palate, others inwards to the nose, and one or two pass backwards to (or, perhaps better, received from) the sympathetic and facial nerves.

ASCENDING BRANCHES.

Ascending series.

The ascending branches, very small, and three or more in number, enter the orbit by the spheno-maxillary fissure, and enter the periosteum.†

DESCENDING BRANCHES.

Descending series consists of palatine nerves.

The descending branches, continued chiefly from the spheno-palatine branches of the upper maxillary nerve (page 549), are the palatine nerves (large, small, and external). They are distributed to the tonsil; to the soft palate—its glandular and muscular substance, and mucous

* A view of the olfactory nerve, and of Meckel's ganglion seen from the inner side. (From Scarpa.) *a.* Elevator muscle of the soft palate thrown down. *b.* Part of the soft palate. *c.* Body of the sphenoid bone. *d.* Internal pterygoid plate. 1. Bulb of the olfactory nerve, giving branches over the upper two spongy bones. 2. Nasal branch of the ophthalmic nerve. 3. Smaller palatine nerve. 4. Meckel's ganglion. 5. Larger palatine nerve, dividing in the roof of the mouth. 6. Vidian nerve. 7. External palatine nerve.

† Bock describes a branch ascending from the ganglion to the sixth nerve; Tiedemann, one to the lower angle of the ophthalmic ganglion. The filaments described by Hirzel as ascending to the optic nerve, most probably join the ciliary nerves which surround that (the optic) nerve.

membrane; to the gums and glands of the hard palate; and to the mucous membrane of the nose.

Larger palatine nerve; The *larger* or *anterior palatine* nerve, fig. 192, [4], descends in the largest palatine canal, and divides in the roof of the mouth into branches, which are received into grooves in the hard palate, and extend forwards nearly to the incisor teeth. In the mouth it supplies the gums, the glandular structure and the mucous membrane on the hard palate, and joins in front with the naso-palatine nerve. When entering its canal, this palatine nerve gives a nasal branch which ramifies on the middle and lower spongy bones; and a little before leaving the canal, another branch is supplied to the membrane covering the lower spongy bone: these are *inferior nasal branches*. Opposite the lower spongy bone springs a small branch, which is continued to the soft palate in a separate canal behind the trunk of the nerve.

its inferior nasal branches.

Smaller palatine nerve. The *smaller* or *posterior palatine* branch, fig. 192, [3], arising near the preceding nerve, enters with a small artery the smaller palatine canal, and by this it is conducted to the soft palate, the tonsil, and the uvula. According to Meckel, it supplies the levator palati muscle.

External palatine nerve: The *external palatine* nerve, fig. 192, [7], the smallest of the series, courses between the upper maxilla and the external pterygoid muscle, and enters the external palatine canal between the maxillary bone and the pterygoid process of the palate bone. At its exit from the canal it gives inwards a branch to the uvula, and outwards another to the tonsil and palate. Occasionally, this nerve is altogether wanting.

sometimes wanting.

INTERNAL BRANCHES.

Internal branches. The internal branches furnished from the ganglion consist of the naso-palatine, and the upper and anterior nasal, which ramify in the lining membrane of the nose.

Upper anterior nasal nerves. The *upper anterior nasal*, fig. 192, are very small branches, and enter the back part of the nasal fossa by the spheno-palatine foramen. Some few are prolonged to the upper and posterior part of the septum, and the remainder ramify in the membrane covering the upper two spongy bones, and in that lining the posterior ethmoid cells.

Naso-palatine nerve; The *naso-palatine nerve* (nervus naso-palatinus,* nerve of

* This nerve was so named by Scarpa, in an Essay (with Engravings) on the nerves of the nose, published in 1785. (Annotationes Anatomicæ,

Cotunnius) (see woodcut in the description of the nose), long and slender, leaves the inner side of the ganglion with the preceding branches, and after crossing the roof of the nasal fossa is directed forwards on the lower part of the septum nasi, between the periosteum and the pituitary membrane, towards the anterior palatine fossa. It descends to the roof of the mouth by a separate canal * which opens below in the centre of the anterior palatine fossa, the nerve of the right side being behind its fellow, and in a distinct canal (Scarpa). In the mouth the two naso-palatine nerves are connected with each other; and they end in several filaments, which are distributed to the papilla behind the incisor teeth, and communicate with the great palatine nerve. In its course along the septum, small filaments are furnished from the naso-palatine nerve to the pituitary membrane. †

on nasal septum;

descends to mouth.

The two united.

POSTERIOR BRANCHES.

The offsets directed backwards from the spheno-palatine ganglion are the Vidian and pharyngeal nerves.

Posterior branches.

The *Vidian nerve* (nerv. Vidianus v. pterygoideus), fig. 192, [6], is so named from the canal of the sphenoid bone in which it is contained. Supposing this nerve to proceed backwards, as is customary in anatomical works, it arises from the back of the ganglion, which seems to be prolonged into it, courses backwards through the Vidian canal, and after emerging from this divides into two branches: one of these, the superficial petrosal, joins the facial nerve, while the other, the carotid branch, communicates with the sympathetic. ‡ Whilst the Vidian nerve is in its canal, it

Vidian nerve;

in osseous canal.

lib. ii.) Scarpa mentions, that when his essay was prepared for the press, an engraving, containing a representation of this nerve, which Cotunnius had caused to be made twenty-three years before, was shown him by Girardi. The engraving had not and has never been published. —It is stated by John Hunter that he dissected the nerve as early as 1754, and repeatedly used the preparation of it in his anatomical lectures. Hunter adds that, in 1782, he showed his drawings and engravings of the nerves of the nose to Scarpa, who was then in London. —See "Observations on certain parts of the Animal Economy:" London, 1786.

* See Osteology, Vol. i., p. 66.

† Scarpa denies the existence of branches on the septum. Consult also Wrisberg, "De nervis arterias venasque comitantibus." (Comment., t. i. p. 374.)

‡ The Vidian nerve is here described, as it was by Meckel, as a single cord, dividing into parts. Some anatomists consider the

gives inwards to the nose some small branches,—the *upper posterior nasal*, which supply the membrane of the back part of the roof of the nose and septum, as well as the membrane covering the end of the Eustachian tube.

Upper posterior nasal offsets.

Branches of Vidian.

The separate course of the branches resulting from the division of the Vidian nerve will be now described.

Superficial petrosal enters skull and joins facial nerve.

The *superficial petrosal branch*, fig. 194, ², enters the cranium through the cartilaginous substance filling the foramen lacerum at the base of the skull. Lying then on the outer side of the carotid artery and beneath the Gasserian ganglion, the nerve is directed backwards in a groove on the petrous portion of the temporal bone to the hiatus Fallopii; and it is finally continued through the hiatus Fallopii to the aqueduct of the same name, where it joins the gangliform enlargement of the facial nerve.

Carotid branch.

The *carotid* or *sympathetic portion* of the Vidian nerve, shorter than the other, is of a reddish colour and softer texture. Like the preceding branch, it is surrounded by the cartilaginous substance filling the aperture (foramen lacerum) at the point of the petrous portion of the temporal bone; and it is inclined backwards, also on the outer side of the carotid artery, to end in the filaments of the sympathetic surrounding that vessel.

Vidian differently viewed.

In accordance with the view taken of the ganglia connected with the fifth nerve, (p. 546,) the parts of the Vidian nerve, above described as directed backwards from the spheno-palatine ganglion, should be considered as beginning from the facial nerve and the carotid plexus, and coursing forwards (either separately or after being united) to join the ganglion and constitute two of its roots, the third root being derived from the spheno-palatine nerves.

Pharyngeal nerve.

The *pharyngeal nerve* is inconsiderable in size, and instead of emanating directly from the ganglion, may be derived altogether from the Vidian. This branch, when a separate nerve, springs from the back of the ganglion, enters the pterygo-palatine canal with an artery, and is lost in the lining membrane of the pharynx behind the Eustachian tube.

Summary.

Parts supplied by upper maxillary nerve.

Summary.—The upper maxillary nerve, with Meckel's ganglion, supplies the integument of the side of the head, and the muscles and integument of the lower eyelid, the side of the nose, and the upper lip. The following parts

petrosal and carotid branches as quite distinct one from another in their whole length, and connected only by being contained in the same fibrous tube.

likewise receive their nerves from the same source, viz., the upper teeth, the lining membrane of the nose and upper part of the pharynx, of the antrum of Highmore, and of the posterior ethmoid cells; the soft palate, tonsil, and uvula; and the glandular and mucous structures of the roof of the mouth.

But few communications take place with other nerves. In the face the upper maxillary nerve joins freely with the facial nerve; it is connected, moreover, through the medium of Meckel's ganglion, with the facial nerve by the superficial petrosal branch of the Vidian, and with the sympathetic by the carotid branch of the same nerve. Its connections with other nerves.

LOWER MAXILLARY NERVE.

The lower maxillary nerve, fig. 190, [5], is the third and largest trunk of the fifth nerve. It furnishes branches to the tongue (the gustatory nerve), to the external ear, to the lower teeth, and to the muscles, and the mucous membrane and integuments about the lower maxillary bone. Outline of nerve.

This nerve is made up of two portions, which are unequal in size, the larger being derived from the Gasserian ganglion, and the smaller being the slender motor root of the fifth nerve. These two parts leave the skull by the oval foramen in the sphenoid bone, and unite immediately after their exit. Two roots. A few lines beneath the base of the skull, and under the external pterygoid muscle, the lower maxillary nerve separates into two primary branches, one of which is higher and smaller than the other. From these divisions, the branches to various parts emanate as follows:— Division into two portions.

The *small*, or *upper portion*, receives nearly all the fibrils of the smaller (motor) root of the fifth nerve, and terminates in offsets to the temporal, masseter, buccinator, and pterygoid muscles. Smaller portion. A few of the filaments of the motor root are applied to the larger division of the nerve, and are conveyed to other muscles, viz., the mylo-hyoideus and the anterior belly of the digastricus, the tensor of the membrane of the tympanum, and the circumflexus palati. The branches will be now considered individually. Its branches are given to muscles.

DEEP TEMPORAL BRANCHES.

The deep temporal branches are two in number, one being placed near the back, the other near the front of the Deep temporal branches.

temporal fossa, and beneath the temporal muscle, to which both are distributed.

The posterior branch. The *posterior branch* (r. temporalis profundus posterior) is of small size, and is sometimes conjoined with the masseteric branch. It courses upwards in a groove in the bone above the external pterygoid muscle.

Anterior branch. The *anterior branch* (r. temporalis profundus anterior) is placed like the preceding between the bone and the pterygoid muscle, and is then reflected over the crest of the sphenoid bone to the fore part of the temporal fossa. It is frequently joined with the buccal nerve, and sometimes with the other deep temporal branch.

MASSETERIC BRANCH.

Masseteric branch This branch is directed outwards also above the external pterygoid muscle, and has an almost horizontal course in front of the articulation of the lower maxillary bone, and through the sigmoid notch of that bone, to the inner surface of the masseter muscle. It ramifies in the muscle nearly to the lower end. reaches inner side of muscle;

offsets. When the nerve passes by the articulation of the lower jaw, it gives one or more filaments to that joint, and occasionally it furnishes a branch to the temporal muscle.

BUCCAL BRANCH.

Buccal branch The buccal branch (ram. buccinatorius, v. buccinatorio-labialis), pierces the substance of the external pterygoid muscle, and courses forwards to the face under cover of the ramus of the lower maxillary bone, passing through the fibres of the temporal muscle. On the buccinator muscle its fibres separate into *two branches*, which will be presently noticed. on outer side of muscle.

Offsets from buccal branch. From the buccal nerve, while passing through the pterygoid muscle is given a branch to that muscle; and after it has passed beyond the pterygoid, two or three ascending offsets are furnished to the temporal muscle. Under the ramus of the maxilla, it gives filaments to the upper part of the buccinator; these perforate the fibres of the muscle, and end in the buccal glands and the mucous membrane lining its inner surface.

Its upper division; The *upper branch* of the two into which the buccal nerve divides communicates with the facial nerve in a plexus

around the facial vein, and supplies the integument and the upper part of the buccinator muscle.

The *lower branch*, directed to the angle of the mouth, forms, like the upper one, a plexus around the facial vein, and is distributed to the integument, to the buccinator muscle and the mucous membrane lining it, as well as (according to Meckel) to the muscles of the angle of the mouth.* lower one.

PTERYGOID BRANCHES.

The pterygoid branches are two in number : one for each of the pterygoid muscles.

The *external pterygoid branch* is most frequently derived from the buccal nerve. It may be a separate offset from the smaller portion of the lower maxillary nerve. Branch to external pterygoid;

The *nerve* of the *internal pterygoid* muscle, fig. 193, is closely connected at its origin with the otic ganglion, and enters the inner or deep surface of the muscle. to internal pterygoid.

The *lower* and *larger division* of the lower maxillary nerve divides into three parts, viz., the auriculo-temporal, gustatory, and lower dental. The auriculo-temporal soon leaves the short common trunk, and the other two nerves separate from each other afterwards, at a variable distance below the base of the skull. Larger division of lower maxillary. Its portions.

AURICULO-TEMPORAL NERVE.

The auriculo-temporal nerve (nerv. temporalis superficialis), fig. 190, as the name implies, is distributed to the ear and the temple.

The nerve often commences by two roots, between which may be placed the middle meningeal artery. It is directed at first backwards, beneath the external pterygoid muscle, to the inner side of the articulation of the jaw ; and then changing its course, turns upwards between the ear and the joint, where it is covered by the parotid gland. Lastly, emerging from beneath the parotid, it divides into two temporal branches. Course behind condyle of jaw.

Branches.—Besides the terminal branches just referred to, the auriculo-temporal nerve furnishes offsets to the ear, Branches.

* "De quinto pare nervorum cerebri," in Ludwig.—"Scriptores Neurologici," t. i.

the temporo-maxillary joint, and the parotid gland, as well as communicating filaments to other nerves. These will be now severally noticed.

Branches to facial nerve and otic ganglion.

Branches communicating with the facial nerve, and the otic ganglion.—The branches which join the facial nerve, commonly two in number, pass forwards around the carotid artery. The filaments to the otic ganglion arise near the beginning of the auriculo-temporal nerve.

Branches to meatus and articulation.

Branches to the meatus auditorius and temporo-maxillary articulation.—The nerves to the meatus, two in number, spring from the point of connection of the facial and auriculo-temporal nerves, and enter the interior of the auditory meatus between the osseous and cartilaginous parts. One or two filaments sometimes perforate the cartilage and are lost on the convex surface of the meatus. The nerve to the articulation comes from the preceding branches, or directly from the auriculo-temporal nerve.

Parotid branches.

The *parotid branches* are given from the nerve while it is covered by the gland.

Lower auricular.

The *auricular branches* are two in number. One of these, the *lower* of the two, arising behind the articulation of the jaw, distributes branches to the ear below the external meatus; and sends other filaments round the internal maxillary artery to join the sympathetic nerve.

Upper auricular.

The *upper auricular branch*, leaving the nerve in front of the ear, enters the integument covering the tragus and the pinna above the external auditory meatus. Both auricular nerves are confined to the outer surface of the ear.—See *Nerves of the External Ear.*

Temporal: posterior,

Temporal Branches.—One of these, the smaller and *posterior* of the two, supplies the anterior muscle of the auricle, and distributes filaments to the upper part of the pinna

anterior.

and the integument above it. The *anterior* temporal branch extends with the superficial temporal artery to the top of the head, and ends in the integument. It is often united with the temporal branch of the upper maxillary nerve.*

GUSTATORY NERVE.

Deep position beneath jaw.

The gustatory nerve, or lingual branch of the fifth, fig. 190, has an oblique direction inwards, under cover of the lower maxillary bone, to the tongue.

* Meckel mentions a communication between this branch and the occipital nerve.

This nerve is deeply placed in the whole of its course, and has the following connections with surrounding parts. At first it is beneath the external pterygoid muscle with the dental nerve, lying to the inner side of that nerve, and is sometimes united to it by a cord which crosses over the internal maxillary artery. In the same place the gustatory nerve is joined at a small angle by the chorda tympani. Next, it is placed between the internal pterygoid muscle * and the lower maxilla; and it is then inclined obliquely inwards to the side of the tongue, over the upper constrictor of the pharynx, (where this muscle is attached to the maxillary bone,) and above the deep portion of the submaxillary gland. Lastly, the nerve is continued along the side of the tongue to the apex, in contact with the mucous membrane of the mouth. Union with chorda tympani. Course to tongue, and along it.

The *branches*, which are few, leave the nerve by the side of the tongue. Some supply the mucous membrane of the mouth and the contiguous salivary glands; some enter the tongue and its papillæ; and others connect the gustatory nerve with the hypoglossal nerve and the submaxillary ganglion. Branches;

The branches to the submaxillary ganglion are two or three in number. See *Submaxillary Ganglion*. to ganglion

Those which are connected with offsets from the hypoglossal nerve form a plexus at the inner border of the hyoglossus muscle. to join ninth nerve;

The branches distributed to the mucous membrane of the mouth are given from the nerve by the side of the tongue, and supply also the gums. to mucous membrane;

Some delicate filaments are likewise distributed to the substance of the sublingual gland. to sublingual gland;

The *lingual* or terminal branches perforate the muscular structure of the tongue, and divide into filaments, which are continued almost vertically upwards to the conical and fungiform papillæ. Near the tip of the tongue the branches of the gustatory and hypoglossal nerves are united. to tongue.

INFERIOR DENTAL NERVE.

The inferior dental nerve (maxillaris inferior, Meckel), fig. 190, is the largest of the three branches of the lower

* It has been observed by Meckel to give filaments to this muscle (op. cit.).

Course. maxillary trunk. It courses forwards through the lower maxillary bone, and terminates on the face.

Connections. Before the nerve enters the canal in the lower maxilla, it has the same relative position as the gustatory nerve, near which it lies,—that is to say, it is first beneath the external pterygoid muscle, and then between the internal pterygoid and the ramus of the lower maxilla, but separated from the muscle by the internal lateral ligament of the articulation. Being then received into the canal appropriated to it and the dental artery in the bone just named, the nerve is conducted forwards beneath the teeth, to which it gives filaments, as far as the foramen (mental) in the side of the bone. Here it bifurcates: one part, the incisor branch, is continued onwards within the bone to the middle line; the other (labial) branch escapes by the foramen to the face.

In maxillary bone.

Division.

Branches. In addition to the *branches* already indicated, the dental nerve, when about to enter the foramen on the inner surface of the ramus of the jaw, gives off a slender offset, the mylo-hyoid branch.

Branch to mylo-hyoid muscle: The *mylo-hyoid branch* is lodged in a groove on the inner surface of the ramus of the maxillary bone, in which it is confined by fibrous membrane, and is distributed to the lower or cutaneous surface of the mylo-hyoideus and to the anterior belly of the digastric muscle.

supplies digastric.

Dental nerves. The *dental branches* supplied to the molar and bicuspid teeth correspond to the number of the fangs of those teeth. Each branch enters the hole in a fang, and terminates in the pulp of the tooth.

Incisor branch. The *incisor branch* has the same direction as the trunk of the nerve; it extends to the middle line from the point of origin of the labial branch, and supplies nerves to the canine and incisor teeth.

Labial branch The *labial* (mental ?) *branch* emerging from the bone by the foramen on the outer surface, divides beneath the depressor of the angle of the mouth into two parts:—

joins facial nerve, One of these, the outer division, supplies the depressor anguli oris and orbicularis oris muscles, and the integument. It communicates with the facial nerve.

and ends in lower lip. The inner portion, the larger of the two, ascends to the lower lip beneath the depressor labii inferioris muscle, to which it gives filaments: the greater number of the branches end on the inner and outer surfaces of the lip. These (inner) branches assist but slightly in forming the plexus of union with the facial nerve.

Summary.—The lower maxillary, or third division of the fifth, is partly a compound nerve. It furnishes a nerve of special sense to the tongue (the gustatory nerve). Cutaneous filaments ramify on the side of the head, and the external ear, in the auditory passage, the lower lip, and the lower part of the face. Branches are furnished to the mucous membrane of the mouth, the lower teeth and gums, the salivary glands, and the articulation of the lower jaw.

Lower maxillary partly a compound nerve.

A nerve of taste.

Branches to skin and mucous membrane:

This nerve supplies the muscles of mastication, viz., the masseter, temporal, and two pterygoid; also the buccinator, the mylo-hyoideus, the circumflexus palati, and the tensor of the tympanum; and the motor part of the fifth nerve being distributed among the branches furnished to these muscles except that to the buccinator, each is a compound nerve. The muscles of the lower lip and angle of the mouth likewise receive offsets from the lower maxillary nerve; but these muscles are furnished with motor branches from the facial nerve.

to muscles, without and with other nerves.

The gustatory nerve communicates with the facial nerve through the chorda tympani, and with the hypoglossal nerve both on the hyo-glossus muscle and in the substance of the tongue. The auriculo-temporal nerve is connected with the same nerve in the substance of the parotid gland. Lastly, the inferior dental joins the facial nerve, forming a large plexus in which the nerves are freely united with each other.

Communications with other nerves.

Ganglia connected with the inferior maxillary nerve.—Two small ganglia (otic and submaxillary), having the general characters and arrangement ascribed to these bodies (page 546), are connected with the lower maxillary nerve: one with the trunk of the nerve, the other with its lingual branch (the gustatory nerve).

Two ganglia connected with inferior maxillary nerve.

OTIC GANGLION.

The otic ganglion (gang. oticum v. auriculare,—Arnold), fig. 193, of a reddish gray colour, is situate on the deep surface of the lower maxillary trunk, nearly at the point of junction of the motor fasciculus with that nerve, and around the origin of the internal pterygoid branch. Its outer side is thus in contact with the lower maxillary nerve; its inner surface is close to the cartilaginous part of the Eustachian tube and the circumflexus palati muscle; and behind it is the middle meningeal artery.

Otic ganglion.

Situation and connections.

Branches.

The nervous filaments attached to this ganglion are divisible into those by which it is connected with nerves, and those given from it to certain muscles.

Roots from fifth and sympathetic.

Connection with nerves—roots.—The ganglion is connected

Fig. 193.*

with the lower maxillary nerve, especially with the branch furnished to the internal pterygoid muscle, and with the auriculo-temporal nerve, and thus obtains motor and sensory fibrils or roots; it is brought into connection with the sympathetic by a filament from the plexus on the middle meningeal artery. This ganglion has likewise a communication with the glosso-pharyngeal and facial nerves by means of the small petrosal nerve prolonged to it from the tympanic plexus.

Connection with glosso-pharyngeal and facial.

Branches to tensors of tympanum and palate.

Branches.—Two small nerves are distributed to muscles—one to the tensor of the membrane of the tympanum, the other to the circumflexus palati. The latter leaves the fore part of the ganglion; the former is directed backwards outside the Eustachian tube to the osseous canal containing the muscle for which it is destined. (See the figure.)

* The otic ganglion seen from the inner side. (From Arnold.) *a.* Internal pterygoid muscle. *b.* Carotid artery with the sympathetic. *c.* Mastoid process. *d.* Membrane of tympanum. *e.* Bones of tympanum. 1. Gasserian ganglion. 2. First trunk of fifth. 3. Second trunk. 4. Third trunk. 5. Branch to tensor palati. 6. Small superficial petrosal nerve. 7. Chorda tympani. The nerve of the internal pterygoid muscle is seen on the muscle.

SUBMAXILLARY GANGLION.

The submaxillary ganglion (ganglion maxillare,—Meckel), fig. 190, is placed above the deep portion of the submaxillary gland, and is connected by filaments with the gustatory nerve. It is about the size of the ophthalmic ganglion. By the upper part or base it receives branches from nerves (roots), whilst from the lower part proceed the offsets which are distributed from the ganglion. Submaxillary ganglion. Position. Size.

Connection with nerves—roots.—A few filaments are derived from the gustatory nerve, and of these one or two are connected with both the fore and back part of the ganglion. The ganglion receives at its hinder part a branch from the facial nerve; this comes from the chorda tympani, being prolonged by the side of the gustatory nerve. The connection with the sympathetic takes place by means of an offset from the filaments on the facial artery. Roots from fifth, facial and sympathetic nerves.

Branches.—Some nerves, five or six in number, radiate to the substance of the submaxillary gland. Others from the fore part of the ganglion, longer and larger than the preceding, end in the mucous membrane of the mouth, and in Wharton's duct.* Branches to submaxillary gland and mucous membrane.

A difference may be noticed between the structures to which the ganglia above described furnish offsets. The otic ganglion supplies muscles exclusively, while the submaxillary ganglion gives no muscular offsets. Contrast between the two ganglia.

SIXTH PAIR OF NERVES.

The sixth cranial nerve (nerv. abducens, par sextum), fig. 188,[5], is distributed exclusively to the outer rectus muscle in the orbit, and from the action assigned to that muscle, it is sometimes named the "abducent nerve" of the eyeball. Abducent nerve.

From the point of origin (before pointed out, p. 517), the nerve courses forwards at the base of the skull, through the cavernous sinus and the sphenoidal fissure to the orbit. It enters the sinus by an opening in the dura mater behind the body of the sphenoid bone, but is Course within the skull;

* According to Meckel ("De quinto pare," &c.), a branch occasionally descends in front of the hyo-glossus muscle, and after joining with one from the hypoglossal nerve, ends in the genio-hyo-glossus muscle.

separated from the blood by the thin lining membrane. In the sinus this nerve lies on the outer side of the carotid artery, and here receives one or two filaments of communication from the sympathetic. In entering the orbit between the heads of the external rectus muscle, it is above the ophthalmic vein. The nerve is distributed to the outer rectus by two or three filaments, which pierce the ocular surface of the muscle.*

ends in external rectus.

SEVENTH PAIR OF NERVES.

Seventh comprises two nerves.

In the seventh cranial nerve of Willis are combined two nerves having a distinct origin, distribution, and function. One of these (facial) is the motor nerve of the face; the other (auditory) is the special nerve of the organ of hearing. Both enter the internal auditory meatus in the temporal bone, but they are soon separated from each other.

FACIAL NERVE.

Facial nerve.

The place of origin of the facial nerve (nerv. durus paris septimi,—Willis; seventh cranial nerve,—Sömmerring) has been mentioned in connection with the account given of the nervous centre (p. 517). Its course being tortuous and its branches numerous, it will be convenient to divide the description of this nerve into two parts; the first part comprising the portion which intervenes between the origin of the nerve and its entrance into the parotid gland; the second extending to the termination of the nerve.

FROM THE ORIGIN TO THE PAROTID GLAND.

Enters auditory aperture;

and aqueduct of Fallopius,

From its place of origin, the facial nerve is inclined outwards with the auditory nerve to the internal auditory meatus. The facial lies in a groove on the auditory nerve, and the two are united in the auditory meatus by one or two small filaments. At the bottom of the meatus the facial nerve enters the aqueduct of Fallopius, and follows the windings of that canal to the surface of the skull. The nerve courses through the temporal bone at

* The sixth nerve, according to Bock ("Beschreibung des Fünften Nervenpaares"—1817), is joined in the orbit by a filament from Meckel's ganglion.

first almost horizontally outwards, between the cochlea and vestibule, to the inner wall of the tympanum; and it is then turned suddenly backwards above the fenestra ovalis towards the pyramid. Where it bends the nerve presents a reddish gangliform enlargement (intumescentia ganglioformis), which marks the junction of several nerves. Opposite the pyramid it is arched downwards behind the tympanum to the stylo-mastoid foramen, by which it leaves the osseous canal. to reach the surface.

Within the temporal bone the facial is connected with several other nerves by separate branches; and immediately after issuing through the stylo-mastoid foramen, it gives off three small branches,—viz. the posterior auricular, digastric, and stylo-hyoid nerves. Branches.

CONNECTING BRANCHES.

Filaments to the auditory nerve.—In the meatus auditorius one or two minute filaments pass between the facial and the trunk of the auditory nerve. With auditory.

Nerves connected with the gangliform enlargement.—About two lines from the beginning of the aqueduct of Fallopius, where the facial nerve swells into a gangliform enlargement, it is joined by the large superficial petrosal branch, fig. 194,[2], from the Vidian nerve. To the same enlargement of the facial nerve are likewise united a filament from the small superficial petrosal nerve, fig. 194,[3], derived from the tympanic nerve;* and lastly, the external superficial petrosal nerve, fig. 194,[4], which is furnished by the sympathetic accompanying the middle meningeal artery.† With Vidian, tympanic, and sympathetic nerves

CHORDA TYMPANI AND NERVE TO THE STAPEDIUS.

The nerve named chorda tympani leaves the trunk of the

* There is a difference in opinion concerning this branch, arising from its smallness and the difficulty of determining from what nerve it is primarily derived. According to one opinion, the small superficial petrosal nerve is the continuation to the otic ganglion of the tympanic nerve (Jacobson's), and is united by a filament to the enlargement of the facial. According to another manner of viewing the nerve, it begins in the swelling on the facial, connects the facial with the otic ganglion, and receives only a filament of union from Jacobson's nerve.

† This nerve, named and described by Bidder, enters a canal on the upper surface of the petrous portion of the temporal bone, external to the small superficial petrosal, and commonly joins the facial beyond the swelling.

Chorda tympani.

facial below the level of the pyramid,* and crosses the tympanum to join the gustatory nerve, along which it is con-

Fig. 194.†

ducted to the tongue. After passing through a short canal behind the tympanum, it enters that cavity by an aperture below the level of the pyramid, and close to the ring of bone containing the membrane of the tympanum; and being invested by the mucous lining of the cavity, it is directed forwards across the membrana tympani and the handle of the malleus to an aperture at the inner side of, or in the

Enters tympanum,

crosses and leaves it.

* Other views are taken of the origin of this nerve. Thus it is said to arise from the gangliform enlargement of the facial, and to accompany this nerve to the foramen by which it enters the tympanum; or, that it is only a prolongation from the large superficial petrosal (Vidian), which courses along the facial nerve without joining it, and becomes the chorda tympani.

† This drawing represents the middle fossa of the base of the skull with the petrous part of the temporal bone cut through so as to expose the nerves joining the facial (from Bidder).—*a*. External ear. *b*. Middle fossa of the skull with the middle meningeal artery branching on it. 1. Facial nerve by the side of the auditory. 2. Large superficial petrosal nerve. 3. Small superficial petrosal nerve lying over the tensor tympani muscle. 4. The external superficial petrosal nerve. 5. Chorda tympani. 6. Eighth nerve.

Glasserian fissure. After emerging from the tympanum through the opening referred to, the nerve lies beneath the external pterygoid muscle, and is inclined obliquely forwards to the gustatory nerve, which it meets at an acute angle. Lastly, coursing along the gustatory nerve, with which it is connected by one or more filaments, the chorda tympani joins the submaxillary ganglion, and ends in the tongue. As this nerve crosses the tympanum it is said to supply the laxator tympani muscle.

Joins gustatory nerve, and ends in tongue.

The nerve to the stapedius muscle arises from the trunk of the facial opposite the pyramid, and passes obliquely inwards to the fleshy belly of the muscle.

Nerve to stapedius muscle.

POSTERIOR AURICULAR BRANCH.

This branch, fig. 195,[2], arises close to the stylo-mastoid foramen. Arrived in front of the mastoid process, it divides into an auricular and an occipital portion; in this situation, either the nerve or one of its branches is further connected with the great auricular nerve of the cervical plexus. It is said to be joined by the auricular branch of the pneumogastric.

Posterior Auricular.

The *auricular division* supplies fasciculi to the retrahent muscle of the ear, and ends in the integument on the posterior aspect of the auricle.

Auricular part.

The *occipital branch* is directed backwards beneath the small occipital nerve (from the cervical plexus) to the posterior part of the occipito-frontalis muscle; it lies close to the bone, and, besides supplying the muscle, gives upwards filaments to the integument.

Occipital part.

DIGASTRIC AND STYLO-HYOID BRANCHES.

The digastric branch arises in common with that for the stylo-hyoid muscle, and is split into many filaments, which enter the digastric muscle: one of these sometimes perforates the digastric, and joins the glosso-pharyngeal nerve near the base of the skull.

Digastric branch.

The stylo-hyoid branch, long and slender, is directed inwards from the digastric branch to the muscle from which it is named. This nerve is connected with the plexus of the sympathetic on the external carotid artery.

Stylo-hyoid branch.

THE NERVE FROM THE STYLO-MASTOID FORAMEN.

Facial nerve in parotid. In this part of its course the facial nerve is continued forwards through the substance of the parotid gland, and divides in the gland, behind the ramus of the lower maxilla,

Its division. into two primary branches, from which numerous offsets spread out over the side of the head, the face, and

Fig. 195.*

the upper part of the neck. The two primary divisions of the nerve are named temporo-facial and cervico-facial: they are at first flattened and subdivided. This part

* Plan of the facial nerve and the superficial branches of the cervical plexus. 1. Facial nerve. 2. Posterior auricular branch. 3. Supra-orbital nerve. 4. Infra-orbital. 5. Lower maxillary labial branch. 6. Great auricular nerve. 7. Superficial cervical nerve. 8. Small occipital. 9 and 10. Clavicular and supra-acromial branches. 11. Great occipital. 12. Spinal accessory nerve.

of the nerve, with its divisions, is known as the "pes anserinus."* Pes anserinus.

The TEMPORO-FACIAL DIVISION, the larger of the two, takes the direction of the trunk of the facial nerve through the parotid gland. Its ramifications and connections with other nerves form a network over the side of the face, extending as high as the temple, and as low as the mouth. These branches are arranged into temporal, malar, and infraorbital sets. Temporo-facial division. Branches.

Near its commencement this division of the facial is connected with the auriculo-temporal nerve (of the fifth) by one or two filaments which turn round the external carotid artery; and it gives some filaments to the tragus of the outer ear. Connection with fifth nerve.

The *temporal branches* ascend over the zygoma to the side of the head. Some end in the anterior muscle of the auricle and the integument of the temple, and communicate with the temporal branch of the upper maxillary nerve near the ear, as well as with (according to Meckel) the auriculo-temporal branch of the lower maxillary nerve. Other branches enter the occipito-frontalis, the orbicular muscle of the eyelids, and the corrugator of the eyebrow, and join offsets from the supraorbital branch of the ophthalmic nerve. Temporal branches.

The *malar branches* cross the malar bone to the outer angle of the orbit, and supply the orbicular muscle. Some filaments are distributed to both the upper and the lower eyelid: those in the upper eyelid join filaments from the lachrymal and supraorbital nerve; and those in the lower lid are connected with filaments from the upper maxillary nerve. Filaments from this series communicate with the malar branch (r. subcutaneus malæ) of the upper maxillary nerve. Malar branches.

The *infraorbital branches*, of larger size than the other branches, are almost horizontal in direction, and are distributed between the orbit and mouth. They supply the buccinator and orbicularis oris muscles, the elevators of the upper lip and angle of the mouth, and likewise the integument. Numerous communications take place with the fifth nerve. Beneath the elevator of the upper lip these nerves are united in a plexus with the branches of the upper Infra-orbital branches.

* The designation appears to have originated in a comparison made by Winslow.

maxillary nerve ; on the side of the nose they communicate with the nasal, and at the inner angle of the orbit with the infratrochlear nerve. The lower branches of this set are connected with the cervico-facial division.

Cervico-facial division. The CERVICO-FACIAL DIVISION of the facial nerve is directed obliquely through the parotid towards the angle of the lower jaw, and gives branches to the face, below those of the preceding division, and to the upper part of the neck. Branches. The branches are named buccal, supramaxillary, and inframaxillary. In the gland this division of the facial nerve is joined by filaments of the great auricular nerve of the cervical plexus, and offsets from it enter the substance of the gland.

Buccal branches. The *buccal branches* are directed across the masseter muscle to the angle of the mouth ; supplying the muscles, they communicate with the temporo-facial division, and join on the buccinator muscle with filaments of the buccal branch of the lower maxillary nerve.

Supra-maxillary branch. The *supramaxillary branch*, fig. 195, sometimes double, gives an offset over the side of the maxilla to the angle of the mouth, and is then directed inwards, beneath the depressor of the angle of the mouth, to the muscles and integument between the lip and chin ; it joins with the labial branch of the lower dental nerve.

Infra-maxillary branches. The *inframaxillary branches* (r. subcutanei colli), fig. 195, perforate the deep cervical fascia, and, placed beneath the platysma muscle, form arches across the side of the neck as low as the hyoid bone. Some branches join the superficial cervical nerve beneath the platysma, others enter that muscle, and a few perforate it to end in the integument.

Summary. *Summary.*—The facial nerve is the motor nerve of the face. Supplies muscles and integument; It is distributed to some of the muscles of the ear, and to the one of the scalp ; to those of the mouth, nose and eyelids; and to the cutaneous muscle of the neck (platysma). It likewise supplies branches to the integument of the ear, to that of the side and back of the head, as well as to that of the face and the upper part of the neck.

and joins other nerves. This nerve is connected freely with the three trunks of the fifth nerve, and with the submaxillary and spheno-palatine ganglia ; with the glosso-pharyngeal and pneumo-gastric nerves ; with the auditory, the sympathetic, and the spinal nerves.

AUDITORY NERVE.

The auditory nerve (nervus mollis paris septimi,—Willis, eighth cranial nerve of Sömmerring) is the special nerve of the organ of hearing, and is distributed exclusively to the internal ear. Nerve of the ear.

As the auditory nerve is inclined outwards from its connection with the medulla oblongata to gain the internal auditory meatus, it is in contact with the facial nerve, but a small arterial branch destined for the internal ear partly separates them. Within the meatus the two nerves are connected to each other by one or two small filaments. Finally the auditory nerve bifurcates in the meatus : one of the parts is the nerve of the cochlea ; the other enters the vestibule of the internal ear. The distribution of these branches will be described with the ear. Enters meatus auditorius, connected with facial nerve. Division.

EIGHTH PAIR OF NERVES.

The eighth cranial nerve is composed of three distinct nerves—the glosso-pharyngeal, pneumo-gastric, and spinal-accessory. Besides issuing from the skull by the same foramen, these nerves have but little in common. Two of them, the glosso-pharyngeal and pneumo-gastric, are attached to the medulla oblongata in the same line, and resemble one another somewhat in their distribution, for both are distributed to the beginning of the alimentary canal. But the other, the spinal-accessory, takes its origin chiefly from the spinal cord, (p. 518,) and is distributed to muscles. Eighth consists of three nerves.

GLOSSO-PHARYNGEAL NERVE.

The glosso-pharyngeal nerve (one division of the eighth pair, ninth cranial nerve of Sömmerring), fig. 197, [1], is destined, as the name implies, for the tongue and pharynx. Glosso-pharyngeal.

This small nerve is directed outwards from its place of origin over the flocculus to the foramen jugulare, through which it leaves the skull with the pneumo-gastric and spinal-accessory nerves, but in a separate tube of dura mater.* In Exit from skull by jugular opening.

* The jugular foramen has two projecting points of bone for the

passing through the foramen, where it is placed somewhat in front of the other nerves, this nerve is contained in a groove, or in a canal in the lower border of the petrous portion of the temporal bone, and presents, successively, two ganglionic enlargements,—the jugular ganglion, and the petrous ganglion.

Ganglia.

In the neck the glosso-pharyngeal nerve is very deeply placed at its commencement, but less so towards its termination. After leaving the skull, it soon appears between the internal carotid artery and the jugular vein; and in its course to the tongue and pharynx is at first directed downwards over the carotid artery and beneath the styloid process and the muscles connected with the process, to the lower border of the stylo-pharyngeus muscle. Here, changing its direction, the nerve curves inwards to the tongue, forming an arch on the side of the neck. In this last part of its course, it is placed on the stylo-pharyngeus and the middle constrictor muscle of the pharynx, above the upper laryngeal nerve; and near the tongue it is beneath the hyo-glossus muscle, where it ends in offsets for the pharynx, the tonsil, and the tongue.

Course outside skull; to tongue and pharynx. Position to surrounding parts.

The *jugular ganglion* * (gang. superius vel jugulare), fig. 198,[4], the smaller of the two ganglia of the glosso-pharyngeal nerve, is situate at the upper part of the osseous groove in which the nerve is laid during its passage through the jugular foramen. Its length is from half a line to a line, and the breadth from half to three-fourths of a line. It is placed on the outer side of the trunk of the nerve, and involves only some of the fibres,—a small fasciculus passing by the ganglion, and joining the nerve below it.

Jugular ganglion. Size and position.

The *petrous ganglion* (ganglion inferius vel petrosum,—Andersch), fig. 198,[5], is contained in a hollow in the lower border of the petrous part of the temporal bone (receptaculum ganglioli petrosi), and measures about three lines in length. This ganglion includes all the filaments of the nerve, and resembles the gangliform enlargement of the facial nerve. From it arise the small branches by which the glosso-pharyngeal is connected with other nerves at the

Petrous ganglion. Size; gives branches.

attachment of separate portions of the dura mater. Thus the foramen is divided into three parts: one in front for the lower petrosal sinus, one behind for the lateral sinus, and a central one for the three nerves.

* This ganglion was known to Ehrenritter, but it has been particularly described by Müller.—See "Medicinische Zeitung herausgegeben von dem Verein für Heilkunde in Preussen." Berlin, 1833; and Müller's "Archiv. f. Anat. u. Physiol." 1834 and 1837.

base of the skull: these are the tympanic nerve, and branches to join the pneumo-gastric and sympathetic.

The *branches* of the glosso-pharyngeal nerve are divisible into two series: in the first will be ranged those derived from the petrous ganglion, and serving chiefly to connect this nerve with others; and the second will comprise the nerves distributed from it in the neck. Branches of the nerve.

CONNECTING BRANCHES, AND TYMPANIC BRANCH.

From the petrous ganglion spring three small filaments: One passes to the auricular branch of the pneumo-gastric, one to the upper ganglion of the sympathetic, or *vice versâ*, and a third to the ganglion of the root of the pneumo-gastric. The last is not very constant. Branches to pneumo-gastric and sympathetic.

The *tympanic branch* (nerve of Jacobson; r. tympanicus), fig. 196,[4], arises from the petrous ganglion, and is conducted to the tympanum by a special canal * in the petrous part of the temporal bone. On the inner wall of the tympanum, fig. 196, the nerve joins with an offset, [5], from the sympathetic in a plexus (tympanic), and distributes filaments to the membrane lining the tympanum and the Eustachian tube, as well as one, [6], to the fenestra rotunda, and another, [7], to the fenestra ovalis. Tympanic nerve. Tympanic plexus.

From the tympanic nerve are given three *connecting branches*, by which it communicates with other nerves; these occupy the channels continued from the osseous canal, through which the nerve enters the tympanum. One branch enters the carotid canal and joins with the sympathetic on the carotid artery.† A second, fig. 196, [8], is united to the large superficial petrosal nerve, as this lies in the hiatus Fallopii. And the third, fig. 196, [9], is directed upwards, beneath the canal for the tensor tympani muscle, towards the surface of the petrous portion of the temporal bone, where it becomes the *small petrosal nerve*;‡ and Tympanic branches to join sympathetic; to large petrosal nerve;

* The orifice of this canal is in the ridge of bone between the jugular fossa and the carotid foramen; and the canal is directed upwards to the inner wall of the tympanum. From it three channels branch off: one bends down to the carotid canal; a second ascends to the hiatus Fallopii; and the third reaches to near the surface of the petrous portion of the temporal bone, external to the hiatus Fallopii.

† Or this filament may be said to spring from the carotid plexus, and join Jacobson's nerve in the tympanic plexus.

‡ Bidder always found the small petrosal nerve in an osseous canal —never on the surface of the bone. This observer states, too, that the

under this name it is continued to the exterior of the skull through a small aperture in the sphenoid and temporal

Fig. 196.*

to otic ganglion and facial nerve.

bones, to end in the otic ganglion. As this petrosal nerve passes by the gangliform enlargement of the facial, it has a connecting filament with that enlargement.†

To facial nerve.

The *branch* to or from the *facial nerve* perforates when present the digastric muscle ; it is connected with the trunk of the glosso-pharyngeal below the petrous ganglion.‡

nerve passes from the skull through the sphenoid bone and the petrous portion of the temporal.—"Neurologische Beobachtungen."

* A drawing of the tympanic nerve from Breschet's work on the ear. A. Squamous part of temporal bone. B. Petrous portion of same. C. Lower maxillary nerve. D. Internal carotid artery. *a*. Tensor tympani muscle. 1. Carotid plexus. 2. Otic ganglion. 3. Glosso-pharyngeal nerve. 4. Tympanic nerve. 5. Branches to carotid plexus. 6. Branch to fenestra rotunda. 7. Branch to fenestra ovalis. 8. Branch to join the large superficial petrosal nerve. 9. Small superficial petrosal nerve. 10. Nerve to tensor tympani muscle. 11. Facial nerve. 12. Chorda tympani. 13. Petrous ganglion of glosso-pharyngeal. 14. Branch to the membrane lining the Eustachian tube.

† Jacobson described an anterior or internal branch from the tympanic nerve to the spheno-palatine ganglion.

‡ There is sometimes another branch to the trunk of the pneumo-gastric.

BRANCHES DISTRIBUTED IN THE NECK.

Carotid branches.

The *carotid branches* course along the internal carotid artery, and unite with the pharyngeal branch of the pneumo-gastric and with branches of the sympathetic.

Pharyngeal branches and plexus.

The *pharyngeal branches*, three or four in number, unite opposite the middle constrictor of the pharynx with branches of the pneumo-gastric and sympathetic to form the *pharyngeal plexus*. Nerves to the mucous membrane of the pharynx perforate the muscles, and extend upwards to the base of the tongue and the epiglottis, and downwards nearly to the hyoid bone.

Muscular branches.

The *muscular branches* are given to the stylo-pharyngeus and constrictor muscles.

Tonsillitic branches.

is *Tonsillitic branches.*—When the glosso-pharyngeal nerve near the tonsil, some branches are distributed on this body in a kind of plexus (circulus tonsillaris). From these nerves offsets are sent to the soft palate and the isthmus of the fauces.

Lingual branches.

Lingual branches.—The glosso-pharyngeal nerve divides into two parts at the border of the tongue. One turns to the upper surface of the tongue, supplying the mucous membrane at its base; the other perforates the muscular structure, and ends in the mucous membrane on the lateral part of the tongue. Some filaments enter the circumvallate papillæ.

Summary.

Summary.—The glosso-pharyngeal distributes branches to the mucous membrane of the tongue and pharynx. The muscles supplied by it are some of those of the pharynx and base of the tongue. It is connected with the following nerves, viz., the lower maxillary division of the fifth, the facial, the pneumo-gastric (the trunk and branches of this nerve), and the sympathetic.

PNEUMO-GASTRIC NERVE.

Pneumo-gastric; longest cranial nerve.

The pneumo-gastric nerve (nervus vagus, par vagum, sympatheticus medius, a division of the eighth pair of Willis, tenth cranial nerve,—Sömmerring), fig. 197, [2], has the longest course of any of the cranial nerves. It extends through the neck and the cavity of the chest to the upper part of the abdomen; and it supplies nerves to the organs

of voice and respiration, to the alimentary canal as far a
the stomach, and to the heart.

Fig. 197.*

THE NERVE, FROM ITS ORIGIN TO THE THORAX.

Origin and The filaments by which this nerve springs from th

* A plan, representing the distribution of the divisions of the eightl pair of cranial nerves (altered from Bell). *a*. Spinal cord. *b*. Sterno mastoid muscle. *c*. Trapezius. *d*. Clavicle. *e*. Scapula. *f*. Sid of the chest. *g*. Tongue. *h*. Larynx. *k*. Diaphragm. *l*. Stomach. 1 Glosso-pharyngeal nerve. 2. Pneumo-gastric. 3. Spinal-accessor nerve. 4. Upper laryngeal branch of vagus. 5. Lower laryngeal o recurrent branch. 6. Pulmonary branches. 7. Some nerves of œso phageal plexus.

medulla oblongata are collected together, so as to give rise to a flat fasciculus, which is directed over the flocculus to the foramen jugulare in the base of the skull. course in cranium.

In passing through the opening at the base of the skull the pneumo-gastric nerve is contained in the same sheath of dura mater, and surrounded by the same tube of arachnoid membrane as the spinal-accessory nerve; but it is separated from the glosso-pharyngeal nerve by a process of membrane. In the foramen the filaments of the nerve become aggregated together; and it here presents a ganglionic enlargement, distinguished as the ganglion of the root of the pneumo-gastric. Exit from skull.

After its passage through the foramen, the vagus nerve is joined by the accessory part of the spinal accessory nerve, and a second ganglion is formed upon it (the ganglion of the trunk of the nerve). Several communications are at the same time established with the surrounding nerves. In its course along the neck the nerve has a straight direction, and a fixed position with respect to the cervical vessels; for, enclosed in the sheath of those vessels it is between the internal carotid artery and the internal jugular vein as far as the thyroid cartilage, and afterwards between the same vein and the common carotid artery. When entering the thorax, the nerve of the right side crosses over the subclavian artery at right angles, and gives the recurrent branch to the larynx round that vessel; but on the left side it is parallel with the subclavian artery, and the recurrent laryngeal branch arises in the chest opposite the arch of the aorta. Course and connections in the neck.

The *upper ganglion*, or ganglion of the root of the pneumo-gastric nerve * (gang. superius v. radicis nervi vagi), fig. 198,[7], is situate in the foramen jugulare. It is of a grayish colour, and resembles the ganglion on the posterior root of the fifth cranial nerve. This body is nearly circular, and about two lines in diameter; it has connecting filaments with other nerves—viz., with the facial, the petrous ganglion of the glosso-pharyngeal, the spinal-accessory, and the sympathetic. Upper ganglion of pneumo-gastric: is in foramen. Connections with nerves.

The *lower ganglion*, or ganglion of the trunk of the Lower ganglion:

* These ganglia have been described particularly by Bendz.—See "Tractatus de Connexu inter Nervum Vagum et Accessorium Willisii." Hen. Car. Bang Bendz. Hauniæ, 1836.—Either the one or the other ganglion had been previously noticed by the greater number of anatomists.

pneumo-gastric nerve * (ganglion inferius v. trunci nervi vagi), fig. 198, [9], is about half an inch below the preceding. Occupying the trunk of the nerve outside the skull, it is of

placed in neck.

Fig. 198.†

a cylindrical form and reddish colour, and measures about ten lines in length and two in breadth. The ganglion does not include all the fibres of the nerve; the fasciculus, which is sent from the spinal-accessory to join the vagus, is the part not involved in the ganglionic substance. It

Does not involve all the nerve.

* This ganglion was named *superior laryngeal* by Sir Astley Cooper, from the supposition that it was the special ganglion of the superior laryngeal nerve, and that it bestowed sensory powers on that nerve.—See a paper in "Guy's Hospital Reports," No. 5. Oct. 1837. London.

† Diagram from Bendz of the ganglia and communications of the divisions of the eighth pair. A. Cerebellum. B. Medulla oblongata. C. Spinal cord. 1. Root of glosso-pharyngeal nerve. 2. Roots of vagus. 3. Roots of spinal-accessory. 4. Jugular ganglion. 5. Petrous ganglion. 6. Tympanic branch. 7. Ganglion of the root of vagus. 8. Auricular branch. 9. Ganglion of the trunk of vagus. 10. Branch from the last to the petrous ganglion. 11. Inner portion of spinal-accessory. 12. Outer portion of the same. 13. Pharyngeal branch of vagus. 14. Upper laryngeal branch. 15. Branches to the sympathetic. 16. Fasciculus of spinal-accessory prolonged with vagus.

communicates with the hypo-glossal and the spinal and sympathetic nerves.

THE PNEUMO-GASTRIC NERVES IN THE THORAX.

In the chest the pneumo-gastric nerves supply branches to the lungs and heart, and are then continued through the cavity along the œsophagus to the stomach. As there is some difference between the nerves of opposite sides in this part of their course, a separate notice of each becomes necessary. **Nerves of opposite sides differ in chest.**

The *right* pneumo-gastric nerve is inclined by the side of the trachea to the back of the root of the lung, where it spreads out in a plexus (posterior pulmonary). From the lower part of the plexus two large cords, the continuation of the nerve, are directed to the œsophagus, on which they subdivide, and, with similar branches of the nerve of the left side, form the œsophageal plexus. Near the lower part of the œsophagus these branches are collected on each side into a single cord; and this cord on the left side is placed on the fore part of the œsophagus, while on the right side it is behind that tube. In this manner the trunks of both nerves are continued into the abdomen. **Nerve of right side:** **is behind œsophagus.**

The nerve of the *left side*, which is placed nearer to the fore part of the thorax than its fellow, lies at first between the left carotid and subclavian arteries, and behind the left innominate vein. Next it crosses over the arch of the aorta, round which turns the recurrent laryngeal branch, and then reaches the back part of the root of the lung. Lastly, the nerve rests on the front of the œsophagus, as before stated. **Left nerve:** **crosses arch of aorta;** **is before œsophagus.**

IN THE ABDOMEN.

Both pneumo-gastric nerves enter the abdomen with the œsophagus, and are distributed to the surfaces of the stomach, the left nerve spreading on the fore part, and the right on the posterior aspect of that organ. Offsets are also given to plexuses of the sympathetic : from the right nerve one to the cœliac plexus, and from the left another to the hepatic plexus. **Both nerves in abdomen.**

BRANCHES OF THE PNEUMO-GASTRIC NERVE.

Branches: arrangement and outline of.

Some of the branches serve to connect the pneumo-gastric with other nerves, and other branches are distributed to the muscular substance or the mucous lining of the organs which the nerve supplies. The principal connecting branches of this nerve are derived from the ganglia. In the different stages of its course branches are supplied to various organs as follows:—In the jugular foramen, a branch is given to the ear; in the neck branches are furnished successively to the pharynx, the larynx, and the heart; and in the thorax additional branches are distributed to the heart, as well as to the lungs and the œsophagus. Terminal branches in the abdomen have been already indicated.

CONNECTING BRANCHES AND AURICULAR BRANCH.

Connecting branches with upper ganglion.

Connections between the upper ganglion of the vagus nerve and the spinal-accessory, glosso-pharyngeal, and sympathetic nerves.—The connection with the spinal-accessory is effected by one or two filaments. The filament to the petrous ganglion of the glosso-pharyngeal is directed transversely; it is not always present. The communication with the sympathetic is established by means of the ascending offset of the upper cervical ganglion.

Auricular branch. Crosses jugular foramen and passes through the bone. Supplies pinna and is connected with facial.

The *auricular branch* is continued to the outer ear. Arising from the ganglion of the root, this branch is joined by a filament from the glosso-pharyngeal nerve, and then turns backwards along the outer boundary of the jugular foramen to an opening near the styloid process. Next, it traverses the substance of the temporal bone, crossing the aqueduct of Fallopius, about two lines from the lower end, and, reaching the surface between the mastoid process and the external auditory meatus, is distributed to the integument of the back of the ear. On the surface it joins with an offset of the posterior auricular branch of the facial nerve.

Connecting branches of second ganglion.

Connections of the second ganglion with the hypoglossal, sympathetic, and spinal nerves.—This ganglion is connected by filaments with the trunk of the hypoglossal, with the upper cervical ganglion of the sympathetic, and with the loop formed between the first two cervical nerves.

BRANCHES FOR THE PHARYNX, LARYNX, AND HEART.

PHARYNGEAL BRANCH.

The pharyngeal branch, fig. 198, [13], arises from the upper part of the ganglion of the trunk of the nerve. In its progress inwards to the pharynx this nerve crosses, in one case over, in another under the internal carotid artery; and it divides into branches which, conjointly with others derived from the glosso-pharyngeal, the superior laryngeal, and the sympathetic nerves, form a plexus (*pharyngeal*) behind the middle constrictor of the pharynx. From the plexus branches are given to the muscular structure, and to the mucous membrane of the pharynx. As the pharyngeal nerve crosses the carotid artery, it joins filaments which the glosso-pharyngeal distributes on the same vessel.—There is sometimes a second pharyngeal branch.

Pharyngeal nerve.

Joins pharyngeal plexus.

SUPERIOR LARYNGEAL BRANCH.

This nerve, fig. 198, [14], springs from the middle of the ganglion of the trunk of the pneumo-gastric nerve. It is directed inwards to the larynx beneath the internal carotid artery, and divides beneath that vessel into two branches, distinguished as external and internal laryngeal, both of which ramify in the structures of the larynx.

Superior laryngeal:

division.

The *external laryngeal* branch, the smaller of the two divisions, gives backwards, at the side of the pharynx, filaments to the pharyngeal plexus and the lower constrictor muscle; and it is finally prolonged beneath the muscles on the side of the larynx to the crico-thyroid muscle * in which it ends. In the neck this branch joins the upper cardiac nerve of the sympathetic.

External branch.

The *internal laryngeal* branch is continued to the interval between the hyoid bone and the thyroid cartilage, where it perforates the thyro-hyoid membrane with the laryngeal branch of the thyroid artery, and sends an offset to join the recurrent branch, after distributing several filaments to the mucous membrane. †

Internal branch.

* Bendz describes branches to the muscles fixed to the oblique line on the thyroid cartilage—viz., to the constrictor, sterno-thyroid, and thyro-hyoid muscles.

† A branch to the arytænoid muscle is sometimes described. It is

The latter ends in mucous membrane of larynx,

Some of the twigs of the internal laryngeal nerve that enter the mucous membrane of the pharynx, communicate with filaments to the same part from the recurrent nerve; others are directed upwards in the arytæno-epiglottidean fold of mucous membrane to the base of the tongue, the epiglottis, and the epiglottidean gland; and others are reflected downwards in the lining membrane of the larynx, extending to the chorda vocalis; these last are placed on the inner side of the laryngeal pouch.

and joins recurrent.

The communicating branch to the recurrent laryngeal nerve is very slender, and lies beneath the lateral part of the thyroid cartilage, under which the junction between the two nerves takes place.

RECURRENT LARYNGEAL BRANCH.

Inferior laryngeal branch.

The recurrent or inferior laryngeal branch of the vagus nerve, fig. 197, [5], as the name expresses, has a reflex course to the larynx, but the point of departure from the vagus nerve, and the connections are not the same on both sides of the body.

Right and left differ in origin.

The nerve on the *right side* arises at the top of the thorax, winds round the subclavian artery, and crosses beneath the common carotid and lower thyroid arteries in its course to the trachea. On the *left side* the recurrent nerve is bent round the arch of the aorta, at the point where the obliterated ductus arteriosus is connected with the arch, and is thence inclined upwards to the trachea.

Course of both nerves.

Each nerve in its course to the larynx is placed between the trachea and œsophagus, supplying branches to both tubes; and, whilst making the turn round its vessel, each gives nerves to the deep cardiac plexus. At the lower part of the cricoid cartilage the recurrent nerve distributes muscular branches, a few offsets to the mucous membrane, and a single communicating filament.

Branches to mucous membrane,

The *branches* to the *mucous membrane* of the pharynx, few in number, unite in their ramifications with branches from the upper laryngeal nerve.

to muscles,

The *muscular branches* supply all the special muscles of the larynx, except the crico-thyroid muscle which is supplied from the upper laryngeal nerve.

difficult to say whether the nerve supplies that muscle, but it appears to do so. A branch enters the muscle, some filaments seem to end in it, and others proceed through it to the mucous membrane.

The *communicating filament* joins the long branch of the upper laryngeal nerve beneath the side of the thyroid cartilage. and to join upper laryngeal.

CARDIAC BRANCHES.

The cervical cardiac branches arise at both the upper and the lower part of the neck. The *upper branches* are small, and join the cardiac nerves of the sympathetic. The *lower*, a single branch, arises as the pneumo-gastric nerve is about to enter the chest. On the right side this branch lies by the side of the innominate artery, and joins one of the cardiac nerves destined for the deep cardiac plexus ; it gives some filaments to the coats of the aorta. The branch of the left pneumo-gastric crosses the arch of the aorta, and ends in the superficial cardiac plexus. Upper and lower cardiac branches.

BRANCHES IN THE CHEST AND ABDOMEN.

CARDIAC BRANCHES.

The thoracic cardiac branches of the right side leave the trunk of the pneumo-gastric, as this nerve lies by the side of the trachea : they pass inwards on the air-tube, and end in the deep cardiac plexus. The corresponding branches of the left side come from the left recurrent laryngeal nerve. Thoracic cardiac branches.

PULMONARY BRANCHES.

Two sets of pulmonary branches are distributed from the pneumo-gastric nerve to the lung ; and they reach the root of the lung, one on its fore part, the other on its posterior aspect. Pulmonary nerves. The *anterior* pulmonary nerves, two or three in number, are of small size. They join with filaments of the sympathetic continued on the pulmonary artery, and with these nerves constitute the *anterior pulmonary plexus.* Anterior branches. Behind the root of the lung the pneumo-gastric becomes flattened, and gives several branches (of much larger size than the anterior branches), which form the *posterior pulmonary plexus* with filaments derived from the third and fourth thoracic ganglia of the sympathetic. Offsets from the last-named plexus extend along the ramifications of the air-tube through the substance of the lung. Posterior branches and plexus.

ŒSOPHAGEAL BRANCHES.

Œsophageal branches and plexus.

The œsophagus within the thorax receives branches from the pneumo-gastric nerves, both above and below the pulmonary branches. The latter are the larger, and are derived from the *œsophageal plexus* (plexus gulæ). This plexus is formed by connecting cords between the nerves of the right and left sides, while they lie in contact with the œsophagus.

GASTRIC BRANCHES.

Left nerves are on front of stomach; right are behind it.

The branches distributed to the stomach (*gastric nerves*) are the terminal branches of both pneumo-gastric nerves. The nerve of the left side, on arriving, guided by the œsophagus, opposite the cardiac orifice of the stomach, divides into many branches : some of these extend over the fore part of the stomach ; others lie along its small curvature, and unite with branches of the right nerve and the sympathetic ; and some filaments are continued between the layers of the small omentum to the hepatic plexus. The right pneumo-gastric nerve distributes branches to the posterior surface and the cardiac end of the stomach ; and a part of this nerve is continued from the stomach to the left side of the cœliac plexus, and to the splenic plexus of the sympathetic.

Summary. Supplies food and air passages and heart. Connection with other nerves.

Summary.—The pneumo-gastric nerves supply branches to the upper part of the alimentary canal, viz., the pharynx, œsophagus, and stomach with the liver and spleen ; and to the respiratory passage, namely, the larynx, trachea, and lungs. These nerves give branches likewise to the heart and great vessels by means of their communication with the cardiac plexus. Each pneumo-gastric nerve is connected with the following cranial nerves—the spinal-accessory, glosso-pharyngeal, facial, and hypoglossal ; also, with some spinal nerves ; and with the sympathetic in the neck, the thorax, and abdomen.

SPINAL-ACCESSORY NERVE.

Spinal accessory nerve, has two parts.

The spinal nerve accessory to the vagus nerve, or, as it is shortly named, the spinal-accessory nerve (nervus spinalis ad par vagum accessorius, eleventh cranial nerve of Sömmerring),

fig. 198, consists of two parts: one (accessory) joins the trunk of the pneumo-gastric; the other (spinal) ends in branches to the sterno-mastoid and trapezius muscles.

The place of origin of this nerve from the upper part of the spinal cord, and its course to the foramen jugulare where it is associated with the other parts of the eighth pair, have been already described, p. 213. *Passes from skull by foramen jugulare.*

The *internal or accessory part*, the smaller of the two, joins in the foramen of exit the ganglion on the root of the vagus by two or three filaments; and having passed from the skull, blends with the trunk of the vagus beyond its second ganglion,* as already said (p. 578). *Internal division, joins vagus.*

The *external portion* of the nerve communicates with the accessory part in the foramen jugulare. Escaped from the foramen, the nerve is directed backwards across the internal jugular vein, in one case over, in another under it, perforates the sterno-mastoid muscle, supplying this with branches, and joining amongst the fleshy fibres with branches of the cervical plexus. Crossing in the next place the neck behind the sterno-mastoid, the nerve passes beneath the trapezius muscle. Here it forms a kind of plexus with branches of the third and fourth cervical nerves, and distributes offsets to the trapezius, which extend nearly to the lower edge of the muscle. Besides the communications between the spinal accessory and the spinal nerves already mentioned, another communication is formed with branches of the cervical nerves in the interval between the two muscles to which the nerve is distributed. *External division. Course to sterno-mastoid; and under trapezius: supplies both. Connection with spinal nerves.*

NINTH PAIR OF CRANIAL NERVES.

The hypoglossal, or ninth cranial nerve (nerv. hypoglossus, par nonum, of Willis, twelfth cranial nerve, of Sömmerring), fig. 199, is the motor nerve of the tongue. *Ninth nerve.*

The filaments by which this nerve arises from the medulla oblongata are collected into two bundles, which converge to the anterior condyloid foramen of the occipital bone. Each bundle of filaments perforates the dura mater separately opposite the foramen, and the two are joined after they have passed through it. *Cranial part of nerve.*

* It is stated by Bendz that a filament is given from the spinal-accessory to the pharyngeal nerve above the place of junction with the vagus, and that fibrils of the same nerve have been traced into each of the muscular offsets of the pneumo-gastric nerve.

Course from base of skull at first downward;

After leaving the cranium, this nerve descends almost vertically to the lower border of the digastric muscle;

Fig. 199.*

then forwards.

where, changing its course, it is thence directed forwards above the hyoid bone, and between the muscles in this situation to the under part of the tongue.

Connections.

As it descends from the base of the skull, the hypoglossal nerve lies at first very deeply with the vagus nerve, to which it is connected; but it gradually approaches nearer to the surface, passing between the internal carotid artery and the jugular vein.

Turns round occipital artery.

Where it curves forward towards the tongue, the nerve turns round the occipital artery, and then crosses the external carotid below the tendon of the digastric muscle. It next sinks under the mylo-hyoid muscle, lying between it and the hyo-glossus, and at the inner border of the latter is connected with the gustatory nerve. Finally, it is continued in the fibres of the genio-hyo-glossus muscle beneath the tongue to the tip, and distributes branches upwards to the muscular substance.

Branches.

The principal *branches* of this nerve are distributed to muscles on the fore part of the neck and to the tongue; a few serve to connect it with some of the neighbouring

* Diagram of the trunk of the hypoglossal nerve. 1. Trunk of the nerve. 3. Descending cervical branch. 4, 5. Two nerves from the second and third cervical nerves to form the arch with the descendens noni.

nerves. The several branches are disposed in the following manner :—

CONNECTING BRANCHES.

Connection with the pneumo-gastric.—Close to the skull the hypoglossal nerve is connected with the second ganglion of the pneumo-gastric by separate filaments, or both nerves are united so as to form but one mass. **Joins vagus.**

With the sympathetic and first two spinal nerves.—Opposite the first cervical vertebra the nerve communicates with the upper cervical ganglion of the sympathetic, and with the loop uniting the first two spinal nerves in front of the atlas. **Sympathetic and spinal.**

MUSCULAR AND LINGUAL BRANCHES.

Descending branch of the ninth nerve.—This branch (r. descendens noni,) fig. 199, leaves the ninth nerve where this turns round the occipital artery, or, it may be, higher up.* It is directed across the sheath of the carotid vessels, from the outer to the inner side, and joins about the middle of the neck in a loop with one or two branches of the cervical plexus. The convexity of this loop is turned downwards; and the connection between the nerves is effected by means of two or more interlacing filaments, which enclose an irregularly-shaped space. From this interlacement of the nerves, filaments are continued backwards to the posterior belly of the omo-hyoid, whilst others are directed forwards to the anterior belly of the same muscle, and to the sterno-hyoid and sterno-thyroid muscles. Occasionally a filament is continued to the chest, where it joins the cardiac and phrenic nerves. **Descendens noni is over sheath of cervical vessels: connection with cervical nerves. Supplies muscles below hyoid bone.**

It is not uncommon to find the descending branch of the ninth nerve in the sheath with the large cervical vessels, and in such cases it may be placed either over or under the vein. **Varies in position.**

Branches to muscles and the tongue.—Branches are distributed to the following muscles, viz. the thyro-hyoid, stylo-glossus, hyo-glossus, genio-hyoid, and genio-hyo-glossus. These branches separate from the nerve where it is contiguous to the several muscles; and that for the thyro- **Nerves to muscles of tongue and hyoid bone.**

* This nerve may be derived altogether from the pneumo-gastric, or from both the pneumo-gastric and hypoglossal nerves.

hyoid muscle near the end of the hyoid bone, before the nerve passes beneath the mylo-hyoid muscle. Lastly, the hypoglossal nerve, when arrived close to the middle of the tongue with the ranine artery, gives off several long slender branches, which pass upwards into the substance of the organ. Some of the branches join with offsets from the gustatory nerve.

Lingual branches.

Summary.

Summary.—The hypoglossal nerve supplies either alone, or in union with branches of the spinal nerves, all the muscles connected with the os hyoides, including those of the tongue, with the exception of the digastric and stylo-hyoid, the mylo-hyoid, and the middle constrictor of the pharynx. The sterno-thyroid muscle receives its nerve from the same source.

It is connected with the following nerves, viz. pneumogastric, gustatory, some spinal nerves, and the sympathetic.

THE SPINAL NERVES.

Definition. THE spinal nerves are characterised by their origin from the spinal cord, and their direct transmission outwards from the spinal canal in the intervals between the vertebræ. Number. Taken together these nerves consist of thirty-one pairs; and, like the vertebræ between which they issue from the spinal canal, they are arranged into groups named cervical, dorsal, lumbar, sacral, and coccygeal. Classes. In these groups the nerves are equal in number to the vertebræ composing the division of the column with which they are associated, but with these exceptions, namely, that eight cervical nerves are recognised, and there is usually but a single coccygeal nerve.*

Each has two roots; place of exit from canal. Division of the trunk. Each spinal nerve springs from the spinal cord by two roots which approach one another, and, with few exceptions, join in the corresponding intervertebral foramen into a single cord; and each cord so constructed separates immediately into two branches, one of which is destined for parts in front of the spine, the other for parts behind it.

Exceptions as to place of exit from canal. The nerves which do not emerge from the spinal canal through intervertebral foramina in the usual way, and on account of which a reservation has been made above, are the first and second cervical, the sacral, and the coccygeal nerve. The two cervical nerves issue from the canal over the laminæ of the vertebræ,—the first over the atlas, the second over the axis; the sacral are transmitted through the apertures in the sacrum; and the last sacral and the coccygeal take their course outwards through the end of the sacral canal.

The connections of the roots of the spinal nerves with the spinal cord, and the manner in which they are disposed with reference to its investing membranes, have been

* Among seven cases which appear to have been examined with great care, Professor Schlemm ("Observat. Neurologicæ," Berolini, 1834) found two coccygeal nerves on each side in one instance, and on one side in another case. In all the rest there was but a single coccygeal nerve on each side. The occurrence of two coccygeal nerves is therefore an exception to the usual arrangement.

treated of already (p. 438, 518, 522). It remains to notice the characters by which the two roots are distinguished, and the peculiarities they present in different sets of nerves.

THE ROOTS OF THE SPINAL NERVES.

Posterior roots; distinctive characters. Size.

The *posterior roots* of the nerves are distinguished from the anterior roots by their greater size, as well as by the greater thickness of the fibrils of which they are composed. But these roots are chiefly characterised by the presence of ganglia. At some distance from the spinal cord the fibrils of the posterior root of an individual nerve are aggregated into two bundles; and these swell, so to say, each into its ganglionic enlargement.

Ganglia.

Size and shape of ganglia.

Ganglia of the spinal nerves.—Each spinal nerve is furnished with a ganglion; but the first cervical or sub-occipital nerve is in some cases without one. The ganglia are proportioned in size to the nerves on which they are formed. They are oval in shape, and many are partly divided or notched at the inner side, the two parts involving the bundles into which the fibrils of the posterior root have been just said to be arranged.

Their position.

The ganglia are placed in the intervertebral foramina, immediately beyond the point at which the roots perforate the dura mater lining the spinal canal. From this statement those on a few nerves are to be excepted. Thus, the first and second cervical nerves, which leave the spinal canal over the laminæ of the vertebræ, have their ganglia opposite those parts. In the sacral nerves they are contained in the spinal canal, that of the last nerve being occasionally at some distance from the point at which the nerve issues. The ganglion of the coccygeal nerve is placed within the canal in the sac of dura mater, and at a variable distance from the origin of the nerve.

Exceptions.

Anterior roots.

The *anterior roots* of the spinal nerves are, as will be inferred from what has been already stated, the smaller of the two; they are devoid of ganglionic enlargement, and their fibrils are collected into two bundles near the intervertebral ganglion, as in the posterior root.

Roots differ in classes of nerves.

The roots of the different groups of spinal nerves vary considerably in size, and some variation is likewise observable in the relative thickness of the fibrils of which they are composed.

Size.—The roots of the upper *cervical nerves* are smaller than those of the lower nerves, the first being much the smallest. The posterior roots of these nerves exceed the anterior in size more than in the other classes of the spinal nerves, and they are likewise composed of fibrils which are considerably larger than those of the anterior roots. The size in cervical nerves.

The roots of the *dorsal nerves*, exception being made of the first which resembles the lowest cervical nerves and is associated with them in its distribution, are of small size, and vary but slightly, or not at all, from the second to the last. The fibrils of both roots are thinly strewed over the cord, and are slender, those of the posterior exceeding in thickness those of the anterior root in only a small degree. Dorsal nerves: their size.

The roots of the lower *lumbar*, and of the upper *sacral nerves*, are the largest of all the spinal nerves; those of the lowest sacral and the coccygeal nerve are, on the other hand, the slenderest of all. All these nerves are crowded together on the lower end of the cord. As regards the relative size of the roots of the same nerves: the anterior are the smaller, but the disproportion between the two is not so great as in the cervical nerves. Lumbar and sacral: size.

Length of the nerves in the spinal canal.—The place at which the roots of the upper cervical nerves are connected with the spinal cord being nearly opposite the foramina by which they leave the canal, these roots are in consequence very short. But the distance between the two points referred to is gradually augmented from nerve to nerve downwards, so that the place of origin of the lower cervical nerves is the breadth of at least one vertebra, and that of the lower dorsal nerves about the breadth of two vertebræ above the foramina by which they respectively emerge from the canal. Moreover, as the spinal cord extends no farther than the first lumbar vertebra, the length of the roots of the lumbar, sacral, and coccygeal nerves increases rapidly from nerve to nerve, and in each case may be estimated by the distance of the foramen of exit from that point. Owing to their length, and the appearance they present in connection with the spinal cord, the aggregate of the roots of the nerves last referred to has been named the "cauda equina."* Length of roots: of upper cervical; of lower cervical and dorsal; of lumbar, sacral, and coccygeal. Cauda equina.

* This designation originated with a comparison made by Laurentius, who, it may be added, regarded the nervous cords which occupy the

Direction of roots.

The direction the roots take within the canal requires brief notice. The first cervical nerve is directed horizontally outwards. The roots of the lower cervical and dorsal nerves at first descend over the spinal cord, held in contact with it by the arachnoid, till they arrive opposite the several intervertebral foramina, where they are directed horizontally outwards. The nerves of the cauda equina are vertical in direction.

Trunk of the nerve.

Division of the nerves.—The two roots of each of the spinal nerves unite immediately beyond the ganglion on the posterior one, and the trunk thus formed separates immediately, as already mentioned, into two branches, anterior and posterior. To these we shall now turn attention, beginning with the latter.

Certain characters common to the posterior branches of all the spinal nerves will be first noticed. Afterwards the arrangement peculiar to each group of nerves (cervical, dorsal, &c.) will be separately considered.

POSTERIOR PRIMARY BRANCHES OF THE SPINAL NERVES.

Posterior branches of nerves smaller than anterior.

Each divides into two.

The posterior branches of the spinal nerves are, with few exceptions, smaller than those given to the fore part of the body. Springing from the trunk which results from the union of the roots of the nerve in the intervertebral foramen, each turns backwards, and soon divides into two parts, distinguished as *external* and *internal*; and these are distributed to the muscles and the integument behind the spine. Exceptions to this general statement respecting the division of the nerves will be found in the arrangement of the first cervical and the lower sacral nerves; the peculiarities which they present will be shown in the special description of those nerves.

lower part of the spinal canal as a portion of the spinal cord. His words are these :—

"Medulla autem è caluariæ rotu'do et amplo foramine prodiens, primum amplissima et crassissima, sensim attenuatur, id est, medullarem substantiam amittit, non corpoream molem quam eandem ubique servat; tandem cùm ad dorsi fines peruenit, tota in funiculos et filamenta caudam fere equinam referentia absumitur."—And. Laurentius, "Histor. Humani Corporis." Lib. x. Cap. xii. Parisiis, 1600.

POSTERIOR PRIMARY BRANCHES OF THE CERVICAL NERVES.

These nerves, except the first two, are directed backwards beneath the posterior intertransverse muscle, and divide behind that muscle into external and internal branches. **Cervical nerves.**

The small *external branches* give only muscular offsets, and are distributed to the splenius and the slender muscles prolonged to the neck from the erector spinæ, viz. the cervicalis ascendens, and the transversalis colli with the trachelo-mastoid. That of the second nerve is the largest of the series of external branches, and is often united to the corresponding branch of the third; it supplies the complexus muscle which covers it, and ends in the splenius and trachelo-mastoid muscles. The first cervical nerve has no offset similar to the external branch of each of the other cervical nerves. **External branches.** **First has none.**

The *internal branches*, which are larger than those above described, are differently disposed at the upper and the lower parts of the neck. Excluding those of the first and second nerves, which require separate notice, they are directed inwards to the spinous processes of the vertebræ; but the branches derived from the third, fourth, and fifth nerves take that course over the semispinalis, and beneath the complexus muscle, and having reached the spines of the vertebræ, are continued outwards to the integument; while, on the other hand, the branches from the lowest three cervical nerves are placed beneath the semispinalis muscle, and end in the muscular structure without furnishing (except occasionally the sixth) any offset to the skin. The last three nerves are the smallest of the series. **Internal branches; position to muscles differs at upper and lower part of neck.**

The muscles supplied by the internal branches just described are the complexus, semispinalis colli, the interspinales, and the multifidus spinæ. **Muscular offsets.**

The *cutaneous branches*, referred to as furnished by the internal branches of some of the cervical nerves, reach the surface by the side of the spinous processes, after passing through the fibres of the complexus (or at the inner side of that muscle), and through the splenius and trapezius muscles; and then turning transversely outwards are distributed in the integument over the trapezius muscle. **Cutaneous nerves.**

The first three cervical nerves deviate more or less from

the arrangement now described, and require to be noticed individually.

PECULIARITIES IN CERTAIN CERVICAL NERVES.

SUBOCCIPITAL NERVE.

Suboccipital nerve. Position in the neck.

The posterior branch of the suboccipital nerve, which is the larger of the two primary branches, emerges over the arch of the atlas, between this and the vertebral artery, to the space bounded by the larger rectus and the two oblique muscles; and after a very short course, divides into branches for the surrounding muscles. One branch descends to the lower oblique muscle and gives a filament through or over the fibres of that muscle, to join the second cervical nerve; another ascends over the larger rectus muscle, supplying it and the smaller rectus; a third enters the upper oblique muscle;* and a fourth sinks into the complexus, where that muscle covers the nerve and its branches.

Branches to muscles.

Occasional cutaneous branch.

A *cutaneous branch* is occasionally given to the back of the head from the suboccipital nerve; it accompanies the occipital artery, and is connected beneath the integument with the great and small occipital nerves.†

SECOND CERVICAL NERVE.

Second cervical.

The posterior primary branch of the second cervical nerve is much the largest of the series. When the nerve has passed through the ligament between the arches of the vertebræ, it lies below the inferior oblique muscle, which it supplies with one or two filaments, and receives a communicating branch from the first nerve. It then separates into external and internal branches; the former of these has been noticed with the corresponding branches from the cervical nerves.

Connection in neck.

Division.

Great occipital nerve.

The *internal branch* of this nerve, from its size and destination named the *great occipital nerve*, is directed

* Asch states that this branch supplies the rectus capitis lateralis muscle. "De Primo Pare Nervorum Medullæ Spinalis," § xxxiii. in Ludwig, "Scriptores Neurologici," vol. i.

† This nerve has occasionally been found in the dissecting room of University College. It was first recognised by James Harrison, M.D. (Session 1839—40), and subsequently traced more fully by E. Hearne, M.B.

upwards on the lower oblique muscle, and is transmitted to the surface through the complexus and trapezius, near their cranial attachments. As soon as the nerve is free from the muscles, it is joined by an offset of the cutaneous part of the third cervical nerve; and ascending with the occipital artery, it divides into branches, which radiate over the occipital part of the occipito-frontalis muscle, some appearing to enter the muscle, and others joining the smaller occipital nerve.

An *auricular branch* is sometimes supplied to the back of the ear by the great occipital nerve, and *muscular branches* are furnished to the complexus. Whilst it is beneath the complexus, the nerve in some cases is joined by an offset from the third cervical nerve. Auricular and muscular branches.

THIRD CERVICAL NERVE.

The posterior branch of the *third cervical nerve* differs from the nerves below it, chiefly in this respect—viz. that in addition to a cutaneous offset to the neck, it furnishes another to the skin over the occiput, which is hence named its occipital branch. Third cervical gives

This *occipital branch* separates from the cervical cutaneous branch beneath the trapezius, perforates that muscle, and ramifies in the integument on the lower part of the occiput, lying at the inner side of the great occipital nerve. It is connected with that nerve. cutaneous branch to occiput.

Between the inner branches of the first three cervical nerves beneath the complexus there are oftentimes communicating fasciculi; and this communication between the nerves M. Cruveilhier has designated as "the posterior cervical plexus." The arrangement referred to can be scarcely said in any case to constitute a plexus, inasmuch as the connecting cords are single, and do not furnish offsets; and, moreover, the connection between the nerves may be altogether wanting. Nerves sometimes connected by loops.

POSTERIOR PRIMARY BRANCHES OF THE DORSAL NERVES.

Like the posterior branches of the other spinal nerves, these are smaller than the anterior (intercostal) from the same nerves, and divide between the transverse processes of the vertebræ into internal and external branches. Dorsal nerves.

The *internal branches* of the upper six nerves appear in Internal

branches; of upper six, of lower six. the interval between the multifidus spinæ and the semi-spinalis dorsi: they supply those muscles, and become cutaneous by the side of the spinous processes of the vertebræ. The same branches of the lower six dorsal nerves are placed between the multifidus spinæ and longissimus dorsi, and end in the former muscle without giving branches to the integument.

External branches. The *external branches* increase in size from above downwards, and the lower five or six give cutaneous offsets. These external branches are directed through or beneath the longissimus dorsi to the space between this muscle and the sacro-lumbalis; they supply both those muscles, together with the small muscles continued upwards from the erector spinæ to the neck, and also the levatores costarum.

Cutaneous nerves; The *cutaneous branches* of the dorsal nerves vary in their position, according as they are derived from the internal or the external branches above described. Those from the of the upper six; internal branches of the upper six nerves perforate the rhomboid and trapezius muscles close to the spines of the vertebræ, and are directed outwards in the integument; the branch from the second nerve reaches as far as the scapula. Gangliform enlargements will be often found on these nerves. The cutaneous nerves given from the external branches of the lower six. emanate from the lower five or six dorsal nerves, and are transmitted to the integument through the lower serratus muscle and the fleshy part of the latissimus dorsi, in a line with the angle of the ribs.

Relative size. It will be observed, that where cutaneous nerves are supplied by the internal branches, there are none from the external branches of the same nerves,* and *vice versâ*; and that the branches which give cutaneous offsets are larger than those that end in muscles without reaching the skin.

POSTERIOR PRIMARY BRANCHES OF THE LUMBAR NERVES.

The branches given backwards from the lumbar nerves resemble those of the lower dorsal nerves in their position between the transverse processes, and their division into

* Valentin states that there are cutaneous nerves from all the external and internal branches; "Sömmerring v. Bau," &c. While this statement is dissented from, it may be remarked that the cutaneous nerves are not always limited to the number mentioned in the text.

internal and external branches between the multifidus spinæ and erector spinæ muscles.

The *external branches* enter the erector spinæ, and give filaments to the intertransverse muscles. From the upper three, cutaneous nerves are supplied; and from the last, a fasciculus descends to the corresponding branch of the first sacral nerve.—The *cutaneous nerves* given from the external branches of the first three lumbar nerves, pierce the fleshy part of the sacro-lumbalis, and the aponeurosis of the latissimus dorsi; they cross the iliac crest near the edge of the erector spinæ, and terminate in the integument of the gluteal region. One or more of the filaments may be traced as far as the great trochanter of the femur.

External branches:

their cutaneous offsets.

The *internal branches* wind backwards in grooves close to the articular processes of the vertebræ, and sink into the multifidus spinæ muscle.

Internal branches.

POSTERIOR PRIMARY BRANCHES OF THE SACRAL NERVES.

These nerves except the last issue from the sacrum through the foramina on the posterior aspect. The first three are covered at their exit from the bone by the multifidus spinæ muscle, and bifurcate like the posterior trunks of the other spinal nerves; but the remaining two, which are below that muscle, have a peculiar arrangement, and require separate examination.

First three; last two.

The *internal branches of the first three* sacral nerves are small, and are lost in the multifidus spinæ muscle.

Internal branches:

The *external branches* of the same nerves are united with one another, and with the last lumbar and fourth sacral nerves, so as to form a series of anastomotic loops on the upper part of the sacrum. These branches are then directed outwards to the cutaneous or posterior surface of the great sacro-sciatic ligament, where, covered by the gluteus maximus muscle, they form a second series of loops, and end in cutaneous nerves.*

and external branches of first three.

The *cutaneous nerves*, derived from the second series of loops last referred to, pierce the great gluteus muscle in the direction of a line from the posterior iliac spine to the

Cutaneous nerves.

* In six dissections the arrangement of these nerves mentioned in the text was the most frequent. The variations to which it is liable are these:—the first nerve may not take part in the second series of loops, and the fourth may be associated with them.

tip of the coccyx. They are commonly three in number, —one is near the innominate bone, another opposite the extremity of the sacrum, and the third about midway between the other two. All are directed outwards over the great gluteal muscle.

Peculiar arrangement of last two.

The *last two sacral nerves* placed, as already stated, below the multifidus spinæ muscle, are smaller than those above them, and are not divided into branches like those nerves. They are connected with each other by a loop on the back of the sacrum, and the lowest is joined in a similar manner with the coccygeal nerve: one or two small filaments from these sacral nerves are distributed behind the coccyx.

POSTERIOR PRIMARY BRANCH OF THE COCCYGEAL NERVE.

Coccygeal nerve.

This branch of the coccygeal nerve is very small, and separates from the anterior primary portion of the nerve in the sacral canal. It is joined by a communicating filament from the last sacral nerve, and ends in the fibrous structure about the posterior surface of the coccyx.

ANTERIOR PRIMARY BRANCHES OF THE SPINAL NERVES.

Anterior trunks.

Size.

Origin.

Exceptions.

The anterior primary branches of the spinal nerves are distributed to the parts of the body situate in front of the vertebral column, including the limbs. They are, for the most part, considerably larger than the posterior divisions of the nerves, and the greater size is attributable to the greater mass of muscular and other structures which they are destined to supply. These nerves spring from the trunk resulting from the union of the two roots of the spinal nerves in the intervertebral foramen, and are thence directed forwards to their destination. The first two cervical nerves deviate from this arrangement: and the sacral and coccygeal nerves have, in some degree, a peculiar disposition. The peculiarities in each of these cases will be noticed in the special description of the nerves.

onnected with sympathetic; form plexuses, except dorsal nerves.

The anterior branch of each spinal nerve is connected by slender filaments with the sympathetic. Lastly, the cervical, lumbar, and sacral nerves form plexuses of various forms; but the dorsal nerves remain separate one from another.

ANTERIOR PRIMARY BRANCHES OF THE FIRST FOUR CERVICAL NERVES.

The four upper cervical nerves form the cervical plexus by their anterior divisions. They appear at the side of the neck between the scalenus medius and rectus anticus major muscles; and divide into two parts, one of which communicates with the nerve above, and the other with the nerve below. Each of these nerves is connected by a communicating filament with the first cervical ganglion, or with the cord connecting that ganglion with the second. Before the description of the plexus resulting from the intercommunication of these nerves is entered on, some peculiarities in the disposition of the first two cervical nerves are to be noticed. **The nerves form plexus; are connected with sympathetic.**

PECULIARITIES IN THE FIRST AND SECOND NERVES.

SUBOCCIPITAL NERVE.

The anterior primary branch of the first nerve runs forwards in a groove on the atlas, and bends downwards in front of the transverse process of that vertebra to join the second nerve. In this course forwards it lies beneath the vertebral artery, and at the inner side of the rectus lateralis muscle to which it gives a branch.* As it crosses the foramen in the transverse process of the atlas, the nerve is joined by a filament from the sympathetic; and from the arch—*loop of the atlas*, it makes in front of that process, branches are supplied to the two anterior recti muscles. Short filaments connect this part of the nerve with the pneumo-gastric, the hypo-glossal, and the sympathetic nerves. **Suboccipital. Course to join second nerve. Branches.**

SECOND CERVICAL NERVE.

The anterior division of the second cervical nerve, beginning between the arches of the first two vertebræ, is directed forwards between their transverse processes, being placed outside the vertebral artery, and beneath the inter- **Second nerve. Course forwards.**

* Valentin notices filaments distributed to the articulation of the occipital bone with the atlas, and to the mastoid process of the temporal bone.

transverse and other muscles fixed to those processes. In front of the intertransverse muscles the nerve divides into an ascending part, which joins the first cervical nerve, and a descending part to the third.

Joins nerves above and below.

CERVICAL PLEXUS.

Formation of plexus.

The cervical plexus is formed by the first four cervical nerves, and distributes branches to some of the muscles of the neck, and to a portion of the integument of the head and of the neck. It is placed opposite the first four vertebræ, beneath the sterno-mastoid muscle, and rests against the middle scalenus muscle and the elevator of the angle of the scapula. The disposition of the nerves in the plexus is easily recognised. Each nerve, except the first, branches into an ascending and a descending part: and these are united in anastomotic loops with the contiguous nerves. From the union of the second and third nerves, superficial branches are supplied to the head and neck; and from the junction of the third with the fourth, arise the cutaneous nerves of the shoulder and chest. Muscular and communicating offsets spring from the same nerves.

Position.

Arrangement of nerves in plexus.

Branches of plexus; superficial and deep.

The *branches* of the plexus will be separated into two sets or classes—a superficial and deep: the former consisting of those which ramify over the cervical fascia, supplying the integument and some also the platysma; the latter comprising branches which are distributed for the most part to the muscles. Again, each of these sets admits of being subdivided into two series, according to the direction the nerves take. Thus, the superficial nerves will be subdivided into ascending and descending; the deep nerves into an internal and external series.

Each set subdivided.

SUPERFICIAL ASCENDING BRANCHES.

SUPERFICIAL CERVICAL NERVE.

This nerve (fig. 195, ^{7},) ramifies in front of the sterno-mastoid muscle. It takes origin from the second and third cervical nerves, turns forward over the sterno-mastoid about the middle, and, after perforating the cervical fascia, divides beneath the platysma myoides into two branches, which are distributed to the anterior and lateral part of the neck.—This nerve may be represented by two or more cords, the

Division into

branches into which it divides when a single nerve being distinct from each other from their commencement in the plexus.*

The *upper branch* gives an ascending offset with the external jugular vein, and communicates freely with the facial nerve (cervico-facial division); it is then transmitted through the platysma to the surface, supplying that muscle, and ramifies in the integument of the upper half of the neck on the fore part, filaments reaching as high as the lower maxilla. The *lower branch* likewise pierces the platysma, and is distributed below the preceding, its filaments extending as low as the sternum. upper branch; lower branch.

While the superficial cervical nerve ramifies over the platysma myoides, the facial nerve is beneath the muscle. According to Valentin many anastomotic arches are formed on the side of the neck between those two nerves, as well as between the branches of the former, one with another.

GREAT AURICULAR NERVE.

This nerve (n. auricularis magnus) (fig. 195, [6],) winds round the outer border of the sterno-mastoid, and is directed obliquely upwards beneath the platysma myoides, between the muscle and the fascia of the neck, to the lobe of the ear. Here the nerve gives a few small offsets to the face, and ends in auricular and mastoid branches. Branches.

The *auricular branches* are directed to the back of the external ear, on which they ramify, and are connected with the offsets derived from the facial nerve. One of these branches reaches the outer surface of the ear by a fissure between the antihelix and the concha. A few filaments are supplied likewise to the outer part of the lobule. Auricular branches.

The *mastoid branch* is united to the posterior auricular branch of the facial nerve, and ascends over the mastoid process to the integument behind the ear. Mastoid branch.

The facial branches of the great auricular nerve, which extend to the integuments of the face, are distributed over the parotid gland. Some slender filaments penetrate deeply through the substance of the gland, and communicate with the facial nerve. Facial branches.

* Valentin describes three superficial cervical nerves, which he names superior, middle, and inferior. "Sömmerring v. Bau," &c.

SMALL OCCIPITAL NERVE.

Course. The smaller occipital nerve (n. occipitalis minor) (fig. 195, [8],) varies in size, and is sometimes double. It springs from the second cervical nerve, and is directed almost vertically to the head along the posterior border of the sterno-mastoid muscle. Distributed to the head. Having perforated the deep fascia near the cranium, the small occipital nerve is continued upwards between the ear and the great occipital nerve, and ends in cutaneous filaments which extend as high as, or higher than the ear; it communicates with offsets from the larger occipital nerve, as well as with the posterior auricular branch of the facial. It appears to supply sometimes the occipito-frontalis muscle.*

Auricular branch. From the small occipital nerve near the ear is given an *auricular branch* (ram. auricularis superior posterior), which is distributed to the upper part of the ear on the posterior aspect, and to the elevator muscle of the auricle. This auricular branch is an offset from the great occipital nerve, when the small occipital has less than its usual size.

SUPERFICIAL DESCENDING BRANCHES.

SUPRA-CLAVICULAR NERVES.

Number. The descending series of the superficial nerves, fig. 195, are thus named. There are two of these nerves, or, in some cases, a greater number. Position in neck. They arise from the third and fourth cervical nerves, and descend in the interval between the sterno-mastoid and the trapezius muscles. Termination. As they approach the clavicle, the nerves are augmented to three or more in number, and are recognised as internal, middle, and posterior.

Inner branch. The *inner* (sternal) branch, which is much smaller than the rest, ramifies over the inner half of the clavicle, and terminates near the sternum.

Middle. The *middle branch*, lying opposite the interval between the pectoral and deltoid muscles, distributes some offsets

* According to Valentin (op. cit.) the small occipital nerve gives branches to the occipito-frontalis muscle, and reaches the upper part of the head. The same anatomist further states that connections take place between the occipital and auricular nerves, some being placed over, and some beneath the occipito-frontalis muscle.

over the fore part of the deltoid, and others over the pectoral muscle. The latter join the small cutaneous offsets of the intercostal nerves.

Posterior.

The *posterior branch* (acromial) is directed outwards over the acromion, and the clavicular attachment of the trapezius muscle, and ends in the integument of the upper and back part of the shoulder.

DEEP BRANCHES: INNER SERIES.

CONNECTING BRANCHES.

Connection with vagus, hypoglossal, and sympathetic.

The cervical plexus is connected near the base of the skull with the trunks of the pneumo-gastric, hypoglossal, and sympathetic nerves, by means of filaments intervening between those nerves and the loop formed by the first two cervical nerves in front of the atlas. (See p. 599.)

MUSCULAR BRANCHES.

Branches to recti;

Branches are supplied to the anterior recti muscles; they proceed from the cervical nerves close to the vertebræ, including the loop between the first two of these nerves (p. 599).

to descendens noni, and muscles below os hyoides.

Other branches, two in number, are connected with the descending branch of the hypoglossal nerve (r. descendens noni), forming with that nerve a small plexus from which the muscles below the os hyoides are supplied (p. 587). One of the branches is derived from the second, and the other from the third cervical nerve. Both branches cross inwards either over or under the internal jugular vein, (the position varying in different cases,) and unite with the branch of the hypoglossal. The junction between these nerves takes place usually in front of the sheath of the large blood-vessels; but in some cases it is within the sheath. The position in either case is determined by that of the branch from the hypoglossal nerve.*

PHRENIC NERVE.

Phrenic nerve.

The diaphragmatic or phrenic nerve, the special nerve of the diaphragm, courses through the thorax to its destination.

* M. Cruveilhier describes an interchange of fibres at the place of connection; so that a filament of the spinal nerve is directed upwards along the branch of the hypoglossal, and *vice versâ*.

It commences from the fourth cervical nerve, and receives usually a fasciculus from another of the nerves (the fifth). As it descends in the neck, the nerve is inclined inwards over the anterior scalenus muscle; and near the chest it is joined by a filament of the sympathetic, also sometimes by another filament derived from the fifth and sixth cervical nerves.

Course in the neck.

As it enters the thorax each phrenic nerve is placed between the subclavian artery and vein, and crosses over the internal mammary artery near the root. Through that cavity each takes nearly a straight direction, in front of the root of the lung on its own side, and along the side of the pericardium,—between this and the mediastinal part of the pleura. Near the diaphragm it divides into branches, which separately penetrate the fibres of that muscle, and then diverging from each other, are distributed on the under surface.

Course in the chest.

Termination in diaphragm.

The two phrenic nerves differ in their connections at the upper part of the thorax, and somewhat in their length.

Difference in connections,

The *right nerve* is placed more deeply than the left, and is at first directed along the outer side of the right innominate vein, and the descending vena cava.

on right side;

The *nerve* of the *left side* is a little the longer of the two, in consequence of the oblique position of the pericardium round which it winds, and also because of the diaphragm being lower on this than on the opposite side. This nerve crosses in front of the arch of the aorta, and the pulmonary artery.

on left side.

Latter is the longer of the two.

Besides the terminal *branches* supplied to the diaphragm, each phrenic nerve gives filaments to the pleura and pericardium; and receives sometimes an offset from the union of the descendens noni with the spinal nerves.*

Branches.

One or two filaments of the nerve of the right side join in a small ganglion with branches to the diaphragm, which are derived from the solar plexus of the sympathetic; and from the ganglion offsets are given to the suprarenal capsule, the hepatic plexus, and the lower vena cava. On the left side there is a junction between the same two nerves near the openings in the diaphragm for the œsophagus and the aorta, but without the appearance of a ganglion.

A ganglion at the union with sympathetic.

* Mr. Swan notices this union as occurring only on the left side. Luschka describes offsets from the lower part of the nerve to the peritoneum, the inferior cava, and the right auricle of the heart.

DEEP BRANCHES: EXTERNAL SERIES.

These nerves are distributed to muscles on the side of the neck, and some are connected freely with the spinal accessory nerve. Deep branches.

MUSCULAR AND CONNECTING BRANCHES.

The sterno-mastoid receives a branch from the second cervical nerve. Two other branches proceed from the third nerve to the levator anguli scapulæ; and from the cervical nerves, as they leave the spinal canal, branches are given to the middle scalenus muscle. Further the trapezius has branches prolonged to it; and thus, like the sterno-mastoid, this muscle receives nerves from both the spinal accessory and the cervical plexus. For sterno-mastoid. Levator scapulæ. Middle scalenus. Trapezius.

Connection with the spinal accessory nerve.—This nerve is connected with the branches of the cervical plexus furnished to the sterno-mastoid,—in the substance of the muscle; also with the branches distributed to the trapezius,—the connection between the nerves being beneath the muscle, and having the appearance of a plexus; and with another offset of the cervical plexus in the interval between the two muscles. Connected with spinal accessory.

Summary of the cervical plexus.—From the cervical plexus are distributed cutaneous nerves to the back of the head, to part of the ear and face, to the anterior half of the neck, and to the upper part of the trunk. The muscles supplied from the plexus are the sterno-mastoid, the platysma, and the lower hyoid muscles in part; the anterior recti, the levator anguli scapulæ, the trapezius, the scalenus medius, and the diaphragm. By means of its branches the plexus communicates with the pneumo-gastric, spinal accessory, hypoglossal, and sympathetic nerves. Summary.

ANTERIOR PRIMARY BRANCHES OF THE LOWER FOUR CERVICAL NERVES.

The large branches of the lower four cervical nerves appear between the scaleni muscles, and go to form the brachial plexus. They are much larger than the corresponding divisions of the upper cervical nerves, and the manner in which they join to form the plexus is different. Go to form brachial plexus.

It commences from the fourth cervical nerve, and receives usually a fasciculus from another of the nerves (the fifth). As it descends in the neck, the nerve is inclined inwards over the anterior scalenus muscle; and near the chest it is joined by a filament of the sympathetic, also sometimes by another filament derived from the fifth and sixth cervical nerves.

Course in the neck.

Course in the chest.

As it enters the thorax each phrenic nerve is placed between the subclavian artery and vein, and crosses over the internal mammary artery near the root. Through that cavity each takes nearly a straight direction, in front of the root of the lung on its own side, and along the side of the pericardium,—between this and the mediastinal part of the pleura. Near the diaphragm it divides into branches, which separately penetrate the fibres of that muscle, and then diverging from each other, are distributed on the under surface.

Termination in diaphragm.

Difference in connections,

The two phrenic nerves differ in their connections at the upper part of the thorax, and somewhat in their length.

on right side;

The *right nerve* is placed more deeply than the left, and is at first directed along the outer side of the right innominate vein, and the descending vena cava.

on left side.

Latter is the longer of the two.

The *nerve* of the *left side* is a little the longer of the two, in consequence of the oblique position of the pericardium round which it winds, and also because of the diaphragm being lower on this than on the opposite side. This nerve crosses in front of the arch of the aorta, and the pulmonary artery.

Branches.

Besides the terminal *branches* supplied to the diaphragm, each phrenic nerve gives filaments to the pleura and pericardium; and receives sometimes an offset from the union of the descendens noni with the spinal nerves.*

A ganglion at the union with sympathetic.

One or two filaments of the nerve of the right side join in a small ganglion with branches to the diaphragm, which are derived from the solar plexus of the sympathetic; and from the ganglion offsets are given to the suprarenal capsule, the hepatic plexus, and the lower vena cava. On the left side there is a junction between the same two nerves near the openings in the diaphragm for the œsophagus and the aorta, but without the appearance of a ganglion.

* Mr. Swan notices this union as occurring only on the left side. Luschka describes offsets from the lower part of the nerve to the peritoneum, the inferior cava, and the right auricle of the heart.

BRANCHES ABOVE THE CLAVICLE.

MUSCULAR AND COMMUNICATING.

The branches which arise from the nerves before their union into a plexus, end in the muscles of the shoulder, and of the side of the neck and the chest, with the exception of a communicating fasciculus to join the phrenic nerve.

Branches for *the Scaleni and Longus Colli Muscles.*—These nerves spring in an irregular manner from the lower cervical nerves close to their place of emergence from the vertebral foramina. **Branch for scaleni and longus colli.**

The branch for *the rhomboid muscles* arises from the fifth nerve, and is directed backwards to the base of the scapula through the fibres of the middle scalenus, and beneath the levator anguli scapulæ. It is distributed to the under surface of the rhomboid muscles, and gives sometimes a branch to the levator scapulæ. **For rhomboideus.**

The nerve *of the subclavius muscle*, of small size, begins in the cord which results from the union of the fifth and sixth cervical nerves. It is directed over the outer part of the subclavian artery to the under surface of the subclavius muscle. This little nerve is commonly connected with the phrenic nerve in the neck or in the chest, by means of a slender filament. **For subclavius.**

Branch *to join the Phrenic Nerve.*—This small branch is an offset from the fifth cervical nerve ; it joins the phrenic nerve on the anterior scalenus muscle. **Branch joins phrenic.**

POSTERIOR THORACIC NERVE.

The posterior thoracic nerve (nerve of the serratus, external respiratory of Bell) is distributed exclusively to the large serratus muscle. Formed in the substance of the middle scalenus muscle by two roots, one from the fifth and one from the sixth nerve, it reaches the surface of that muscle lower than the nerve of the rhomboideus, and is often connected with that nerve. After emerging from the scalenus muscle, the posterior thoracic nerve descends behind the brachial plexus on the outer surface of the serratus magnus, and extends nearly to the lower border of this last muscle, supplying it with several branches (fig. 204). **Posterior thoracic is the nerve of the serratus magnus.**

Connection with sympathetic. Each of these nerves is connected by a filament with the sympathetic,—the part of that nerve in the immediate neighbourhood of each, *i. e.* with one of the two lower cervical ganglia, or with the plexus on the vertebral artery.

BRACHIAL PLEXUS.

Nerves which form plexus. This large plexus, from which the nerves of the upper limb are supplied, is formed by the union of the anterior trunks of the four lower cervical and first dorsal nerves; and it further receives a fasciculus from the last of the nerves (fourth), which goes to form the cervical plexus. Its extent. The plexus reaches from the lower part of the neck to the axillary space, and terminates opposite the coracoid process of the scapula in large offsets for the supply of the limb. From the interval between the anterior and middle scaleni muscles the nerves descend beneath the clavicle, lying at first on the outer side of the large artery (subclavian and axillary), and afterwards in more close connection with the vessel. In the neck they have little of a plexiform arrangement, but they enter into various communications in the axilla, and to the aggregate of all the term brachial plexus is applied.

Arrangement of nerves in plexus. The manner in which the nerves are disposed in the plexus is liable to some variation, but the following may be regarded as the arrangement most frequently met with. The fifth and sixth cervical are joined at the outer border of the scalenus, and then receive the seventh nerve,—the Three cords formed. three nerves giving rise to one great cord. The eighth cervical and first dorsal nerves are united in another cord whilst they are between the scaleni muscles. The two cords thus formed lie side by side, and external to the axillary vessels. Lastly, a third cord is produced opposite the clavicle, or a little lower than this, by the union of a fasciculus from each of the other two. The three cords of which the plexus now consists, are placed as follows:—one on the outer side of the axillary artery, one on the inner side, and one behind that vessel. The large nervous cords which constitute the plexus at the lower end are continued into the branches for the arm.

Branches divided into two sets. *Branches.*—The branches furnished by the foregoing nerves are numerous, and may be conveniently divided into two classes—viz. those that arise above the clavicle, and those that take origin below the bone.

Some difference will be found between the statements of anatomists who have investigated the point—for instance, Scarpa ("Annotationes Anatom.") and Kronenberg, ("Plex. nervor. Structura et Virtutes,") —with respect to the nerves to which the branches are assigned. Such difference is owing doubtless to the variation which actually exists in different cases.

ANTERIOR THORACIC NERVES.

The anterior thoracic nerves, two in number, supply the pectoral muscles. They are distinguished as external and internal. Two anterior thoracic.

The *external*, or more superficial branch, crosses inwards over the axillary artery, and terminates in the great pectoral muscle. External.

The *internal*, or deeper branch, comes forwards between the axillary artery and vein to the small pectoral muscle, and is joined by a branch from the preceding. This nerve presents a plexiform division beneath the small pectoral muscle, and supplies branches to it and the larger pectoral muscle. The two preceding nerves are connected by a filament which forms a loop over the artery at the inner side. Internal. They form a loop on artery.

SUBSCAPULAR NERVES.

These nerves are three in number. They are distinguished as upper, lower, and long subscapular, and are destined for the subscapularis, teres major, and latissimus dorsi muscles. Three subscapular.

The *upper* nerve, the smallest of the subscapular nerves, penetrates the upper part of the subscapular muscle. The *lower* nerve gives a branch to the subscapularis at its axillary border, and ends in the teres major muscle. There is sometimes a distinct nerve for the last-named muscle. Upper: Lower:

The *long subscapular* nerve, the largest of the three, runs along the lower border of the subscapular muscle to the latissimus dorsi, to which it is distributed. Long subscapular.

CIRCUMFLEX NERVE.

The circumflex or axillary nerve (fig. 201) gives both muscular and cutaneous nerves to the shoulder. At first this nerve is placed behind the axillary artery, but at the lower border of the subscapular muscle it is inclined backwards, and separates into an upper and a lower branch. Circumflex nerve. Divides into two parts.

SUPRASCAPULAR NERVE.

Supra-scapular is nerve of supraspinatus and infraspinatus.

The suprascapular nerve arises from the first cord of the plexus, and bends beneath the trapezius to the dorsal surface of the scapula, where it is placed between the muscles and the bone. Entering the supraspinous fossa of the scapula, through the notch in the upper border, (beneath the ligament which crosses the notch,) the suprascapular nerve supplies two branches to the supraspinatus, one being near the upper, the other one near the lower part of the muscle; and it is then transmitted in front of the spine of the scapula to the infraspinous fossa, where it ends in the infraspinatus muscle. In the upper fossa of the scapula, a slender *articular filament* is given to the shoulder-joint, and in the lower fossa other offsets enter the same joint and the bone (scapula).

Gives nerve to shoulder-joint.

BRANCHES BELOW THE CLAVICLE.

These, the remaining offsets of the brachial plexus, supply muscles on the fore part of the chest, some of the muscles and the integument of the shoulder, and the remainder of the upper limb.

Origin of branches from

Origin of nerves from the plexus.—The several nerves now to be described are derived from the three great cords of the plexus in this order.

outer,

From the outer cord,—the external of the two anterior thoracic nerves, the outer head of the median, and the musculo-cutaneous.

inner,

From the inner cord,—the inner of the two anterior thoracic, the internal cutaneous and ulnar, the nerve of Wrisberg, and the inner head of the median.

posterior cord.

From the posterior cord,—the subscapular nerves, the circumflex, and the musculo-spiral.

Origin of branches from spinal nerves.

The nerves traced to the spinal nerves.—If the fasciculi of which the principal nerves are composed be followed through the plexus, they may be traced to the spinal nerves named for each trunk in the subjoined table. The higher numbers refer to the cervical nerves, the unit to the dorsal nerve :—

Subscapular from . .	5.6.7.8.	Ulnar nerve	5.6.7.8.1. or 7.8.1. or 8.1.
Circumflex . . .	5.6.7. or 5.6.7.8.1.	Median nerve	5.6.7.8.1. or 5.6.7.8.
Internal cutaneous . .	8.1.		
Smaller internal cutaneous .	8.1.	Musculo-spiral .	6.7.8.
External cutaneous, from 5.6.7.			

nerve, (nerve of Wrisberg,) and afterwards communicates with the outer portion of the internal cutaneous.*

Cutaneous offset in upper arm.

Near the axilla the internal cutaneous gives an offset (fig. 200,[8]) through the fascia to the integument of the arm. This small branch lies a little to the outer side of the nerve from which it springs, and reaches to, or nearly to the elbow, distributing filaments outwards to the integument over the biceps muscle. The same branch is often connected with the intercosto-humeral nerve.

Fig. 200.†

Summary.

Summary.—The internal cutaneous nerve gives filaments to the inner and fore part of the arm, and to the inner part of the fore arm on the anterior and the posterior surface. Its offsets are connected with the smaller internal cutaneous nerve, and with the ulnar nerve.

SMALL INTERNAL CUTANEOUS NERVE.

Nerve of Wrisberg.

The smaller internal cutaneous nerve (nerv. cutaneus internus minor vel ulnaris Wrisbergii,—Klint,‡ fig. 200,[9],) assists the larger internal cutaneous nerve in supplying the inner side of the arm.

Place of origin from plexus.

This nerve commonly arises from the inner cord of the brachial plexus in union with the larger internal cutaneous and ulnar nerves.

Position.

In the axilla the nerve of Wrisberg is concealed at first by the axillary vein, but it soon appears on the inner side of that vessel, and communicates with the intercosto-humeral nerve. It is then placed along

* Mr. Swan describes a connection near the wrist between this branch and the dorsal branch of the ulnar nerve.

† Plan of the cutaneous nerves on the front of the arm.—1. Supraclavicular nerves. 2. Branches of the circumflex nerve. 3. External cutaneous (upper branch) of the musculo-spiral nerve. 4. Musculo-cutaneous. 5. Branch of ulnar nerve. 6. Internal cutaneous: external branch. 7. Inner branch of that nerve. 8. Offset to the upper arm from same. 9. Nerve of Wrisberg. 10. Intercosto-humeral nerve.

‡ This nerve appears to have been first made known by Wrisberg in

Perforates fascia.

the inner side of the brachial vessels to about the middle of the arm, where it pierces the fascia, and is continued immediately beneath the integument to the interval between the internal condyle of the humerus and the olecranon (fig. 202,[6]).

Branches to integument of the arm.

Branches.—In the lower third of the arm, branches of this little nerve are directed almost horizontally to the integument on the posterior aspect; and the nerve ends at the elbow by dividing into several filaments, some of which are directed forwards over the inner condyle of the humerus, while others are prolonged downwards behind the olecranon.

Connection with intercosto-humeral.

Connection with intercosto-humeral nerve.—The connection between the nerve of Wrisberg and the intercosto-humeral nerve presents much variety in different cases :—in some, there are two or more intercommunications, forming a kind of plexus on the posterior boundary of the axillary space; in others, the intercosto-humeral nerve is of larger size than usual, and takes the place of the nerve of Wrisberg, only receiving in the axilla a small filament from the brachial plexus, and this small communicating filament represents in such cases the nerve of Wrisberg.

Summary.

Summary.—The nerve of Wrisberg is the cutaneous nerve of the lower half of the upper arm on the inner and posterior aspect. It supplies the skin below the cutaneous branch of the musculo-spiral nerve.

MUSCULO-CUTANEOUS NERVE.

Musculo-cutaneous: outline of nerve.

The musculo-cutaneous or external cutaneous nerve (fig. 201,[5]) supplies branches to the muscles of the arm, and to the integument of the fore arm. It is deeply placed between the muscles as far as the elbow, and below that point is immediately under the integument.

Course and connections of muscular part.

Muscular part.—Arising from the brachial plexus opposite the small pectoral muscle, this nerve perforates the coraco-brachialis muscle;* and passing obliquely across the arm

his lectures; and the first published account of it is contained in an Essay by one of his pupils; see Klint, "De Nervis Brachii," in Ludwig "Script. Neurol. min." tom. iii.

* The nerve is sometimes named "perforans Casserii," the first term of this designation having reference to the mode in which the nerve is connected with the coraco-brachialis muscle. As regards the association of the name of Casserius with the musculo-cutaneous nerve, it should

between the biceps and brachialis anticus muscles reaches the outer side of the limb a little above the elbow. Here it perforates the fascia and commences its subcutaneous course on the fore arm, which will be presently described.

Branches.—As it descends through the arm, the nerve distributes branches to the muscles as follows:—Before it reaches the coraco-brachialis, one branch is given to that muscle and to the short head of the biceps; and other filaments are furnished to the coraco-brachialis, while the nerve lies amongst its fibres. Lower down, where the nerve is placed between the biceps and brachialis anticus, branches are supplied to both those muscles. Lastly, the humerus and the elbow-joint receive small filaments from the same source. Muscular branches.

The *cutaneous part* of the musculo-cutaneous nerve (fig. 200,[4]), approaching the integument at the outer side of the biceps muscle, and nearly opposite the elbow-joint, crosses behind the median-cephalic vein, and inclining outwards, divides into two branches which supply the integument on the outer side of the fore arm, one on the anterior, the other on the posterior aspect. Cutaneous part; position. Two branches.

The *anterior branch* descends near the radial border of the fore arm. It is placed in front of the radial artery near the wrist, and distributes some filaments over the ball of the thumb. Piercing then the fascia, it accompanies the artery to the back part of the carpus. This branch is connected at the wrist with an offset of the radial nerve. Anterior, with radial artery.

The *posterior branch* of the external cutaneous nerve is directed outwards to the back of the fore arm, and ramifies in the integument of the lower third, extending as far as the wrist (fig. 202,[10]). It communicates with a branch of the radial nerve, and with the external cutaneous branch of the musculo-spiral nerve. Posterior branch. Position.

Summary.—The musculo-cutaneous nerve supplies three muscles in front of the humerus, and the integument on the outer side of the fore arm. Communications are established between it and the radial and the external cutaneous branch of the musculo-spiral. Summary.

Some *peculiarities* of the nerve.—In some cases it does not perforate Variation

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be mentioned that this anatomist named the muscle "perforatus," but he does not appear to have distinguished the nerve in the manner which seems to be implied. See "Julii Casserii Placentini Tab. Anatom:" (D. Bucretius explicat. addidit), Tab. 19 and 20. Francforti, 1632.

in course of the nerve. the coraco-brachialis muscle. It is from time to time found to be an offset of the median nerve; and in this case, the coraco-brachialis muscle receives a separate branch from the brachial plexus.

ULNAR NERVE.

Outline of nerve. The ulnar nerve (fig. 201,[7]) supplies both muscular and cutaneous branches to the fore arm and the hand. In its whole course it lies along the inner (ulnar) side of the limb.

Position in the armpit, At its commencement the ulnar nerve lies at the inner side of the axillary artery, and retains the same position with respect to the brachial vessels nearly to the middle of the arm. From this point it gradually inclines inwards, and course in the arm. passing through the internal inter-muscular septum to the interval between the olecranon and the inner condyle of the humerus, and reaches the fore arm between the two heads of the flexor carpi ulnaris. From the axilla to the place at which it sinks beneath the muscle last named, the nerve is covered only by the fascia, and may be felt through the integument a little above the elbow.

Position in the fore arm. IN THE FORE ARM :—The ulnar nerve extending in a straight course to the outer side of the pisiform bone of the carpus, is concealed by the flexor carpi ulnaris as far as the middle of this part of the limb; and thence onwards, it lies at the outer side of the same muscle, covered only by the integument and fascia. In the whole course from the elbow to the carpus, it rests against the deep flexor of the Connection with ulnar artery. fingers; and the ulnar artery, which is separated from the nerve by a considerable interval at the elbow, is in contact with it (on the outer side) in the lower half of the fore arm.

Branches. *Branches.*—In its course along the upper arm the ulnar nerve gives off no branch. The offsets derived from it at the elbow and in the fore arm are as follows :—

Articular. *Articular nerves.*—These consist of some small filaments supplied to the elbow-joint, as the nerve passes close behind the joint.

Muscular. *Muscular branches.*—One branch enters the upper part of the flexor carpi ulnaris, and another supplies the two inner divisions (the inner half) of the deep flexor of the fingers.

Cutaneous in fore arm. *Cutaneous branches.*—These are two small nerves that arise about the middle of the fore arm by a common trunk.

One pierces the fascia, and turning downwards, joins a branch of the internal cutaneous nerve (fig. 200,[5]). This branch is often absent.

Palmar.

The second, a *palmar branch*, lies on the ulnar artery, which it accompanies to the hand. This little nerve gives filaments around the vessel, and ramifies in the integument of the hand, joining in some cases with other cutaneous offsets of the ulnar or median nerve.

Fig. 201.*

Dorsal branch supplies fingers,

Dorsal branch of the hand.—This large offset (fig. 203,[6]), leaving the trunk of the ulnar nerve about two inches above the wrist, winds backwards beneath the flexor carpi ulnaris, and divides into branches; one of which ramifies on the inner side of the little finger, and the other divides to supply the contiguous sides of that finger and the ring finger. On the back of the metacarpus this nerve joins with the radial nerve. The several posterior digital nerves, now described, are united with offsets directed backwards from the anterior digital nerves of the ulnar in front.

and joins radial and anterior digital nerves.

Articular.

Articular nerves. — Besides the foregoing branches the ulnar nerve supplies some filaments to the wrist-joint.

* A plan of the nerves of the arm. A. Axillary artery. B. Brachial

Palmar part of nerve.

Palmar part of ulnar nerve.—On the annular ligament, or somewhat beyond it, the nerve separates into two parts, one of which is superficial, and the other is deeply placed in the hand.

Superficial part.

The *superficial branch* accompanying the ulnar artery supplies digital nerves at the inner side of the hand, and gives likewise a branch to the palmaris brevis muscle, and offsets to the integument.*

Digital nerves for little finger and one side of ring finger.

Digital nerves.—One of these belongs to the ulnar side of the little finger. The other is connected in the palm of the hand with a digital branch of the median nerve, and at the cleft between the little and ring fingers, gives an offset to the opposed sides of each. The disposition of the digital branches on the fingers is the same as that of the median nerve, to be presently described.

Deep palmar nerve

The *deep palmar portion* of the ulnar nerve follows the course of the deep palmar arch of vessels, beneath the long flexor tendons, and in contact with the interosseous muscles.

supplies muscles of little finger and some of thumb, interossei, lumbricales.

Branches. —At its commencement, branches leave the deep palmar nerve to supply the small muscles of the little finger. As it lies across the metacarpal bones, it distributes two branches to each interosseous space—one for the palmar, the other for the dorsal interosseous muscle, and supplies filaments to the two innermost lumbricales muscles. Opposite the space between the thumb and the index finger the nerve ends in branches to the adductor pollicis, and the inner head of the flexor brevis pollicis.

Summary. Cutaneous,

Summary.—The ulnar nerve gives cutaneous filaments to the lower part of the fore arm (to a small extent), and to the hand on its palmar and dorsal aspects. It supplies the

muscular,

following muscles, viz. : the ulnar flexor of the carpus, the deep flexor of the fingers (its inner half), the short muscles of the little finger with the palmaris brevis, half of the short muscles of the thumb, and the interosseous muscles of

and articular branches.

the hand, with the two internal lumbricales. Lastly, it contributes to the supply of the elbow and wrist joints.

artery. Nerves: 2. Supra-scapular. 3. Subscapular. 4. Internal-cutaneous. 5. Musculo-cutaneous. 6. Circumflex. 7. Ulnar. 8 Superficial branch of the same on the hand. 12. Median. 13. Anterior interosseous. 15. Musculo-spiral. 16. Radial. 17. Posterior interosseous.

* These may be found to communicate with the palmar nerves given from the median or ulnar.

MEDIAN NERVE.

This nerve (fig. 201) is placed along the middle of the limb (whence its name), and it occupies a position intermediate between the ulnar and the musculo-spiral (with the radial) nerves. Beginning by two roots—one from the outer, the other from the inner cord of the brachial plexus, which unite before or on the outer side of the axillary artery—the nerve is in contact with that vessel and its continuation, the brachial artery, nearly to the elbow. Near the elbow-joint it is placed at the inner side of the vessel, having crossed obliquely over it.

Median nerve. Position, and connections in arm.

IN THE FORE ARM.

The median nerve, after passing between the two heads of the pronator teres, is placed between the superficial and the deep flexor muscles of the fingers, until it arrives at the lower end of the fore arm. Here it is covered only by the integument and the fascia for a short space, and it lies between the radial flexor of the carpus and the superficial flexor of the fingers. Finally, the nerve leaves the fore arm beneath the anterior annular ligament of the carpus.

Position in fore arm.

Branches.—The median nerve gives usually no offset in the upper arm. In the fore arm it distributes branches to the muscles in its immediate neighbourhood, and a single cutaneous filament. These are disposed as follows:—

Branches.

Muscular branches.—All the muscles on the front of the fore arm (pronators and flexors), except the flexor carpi ulnaris and part of the deep flexor of the fingers, are supplied from the median nerve. The several branches separate from the nerve near the elbow-joint, but the branch furnished to the pronator teres often arises above the joint.

To muscles of the fore arm.

Anterior interosseous nerve.—This is the longest branch of the median nerve, and it supplies the deeper muscles of the fore arm. Commencing at the upper part of the fore arm, beneath the superficial flexor of the fingers, the interosseous nerve courses downwards with the anterior interosseous artery on the interosseous membrane, and between the long flexor of the thumb and the deep flexor of the fingers, to the pronator quadratus muscle in which it ends.

Anterior interosseous between deepest muscles,

and supplies them. In its progress downwards offsets are distributed to the two muscles between which the nerve lies.

Cutaneous palmar branch. *Cutaneous palmar branch.*—This small nerve pierces the fascia of the fore arm close to the annular ligament, and after crossing over that ligament, ends in the integument of the palm about the middle. It is connected with the cutaneous palmar branch of the ulnar nerve, and distributes some filaments over the ball of the thumb. The filaments last referred to communicate with offsets of the radial or the external cutaneous nerve.

THE MEDIAN NERVE IN THE HAND.

Position of nerve in hand. After passing from beneath the annular ligament of the carpus, the median nerve is covered by the palmar fascia and the integument, and rests against the tendons of the flexor muscles. Somewhat enlarged, and slightly reddish in colour, it here separates into two parts of nearly equal size. One of these (the external one) supplies some of the short muscles of the thumb, and gives digital branches to the thumb and the index finger; and the second portion supplies the middle finger, and in part the index and ring fingers. The branches thus indicated are distributed as below:—

Separates into two primary parts.

Supplies part of muscles of thumb. *Branch to muscles of the thumb.* — This short nerve subdivides for the abductor, the opponens, and the outer head of the flexor brevis pollicis muscle.—The remainder of the small mass of muscles of the thenar eminence (the part placed at the inner side of the long flexor tendon) is supplied by the ulnar nerve.

Digital nerves. *Digital nerves.*—The digital nerves are five in number, and belong to the thumb, and the fingers as far as the outer side of the ring finger. As they approach the clefts between the fingers, these nerves are close to the integument in the intervals between the processes of the palmar fascia: the three external remain undivided, but the fourth and fifth bifurcate and supply each the contiguous sides of two fingers.

First and second. The *first* and *second* nerves lie along the side of the thumb; and the former (the outer one) is connected with the radial nerve over the ball of the thumb.

Third. The *third*, destined for the radial side of the index finger, gives a muscular branch to the first or most external lumbrical muscle.

The *fourth* supplies the second lumbricalis, and divides into branches for the opposed sides of the index and middle fingers. Fourth.

The *fifth*, the most internal of the digital nerves, is connected with the ulnar nerve, and splits to furnish branches to the ring and middle fingers. Fifth.

Each digital nerve divides at the end of the finger into two branches, one of which supplies the ball on the fore part of the finger; the other ramifies in the pulp beneath the nail. Branches pass from each nerve forwards and backwards to the integument of the finger; and one larger than the rest inclines backwards by the side of the first phalanx of the finger, and after joining the dorsal digital nerve, ends in the integument over the last phalanx. Arrangement of digital nerves.

Summary.—The median nerve gives cutaneous branches to the palm, and to several fingers. It supplies the pronator muscles, the flexors of the carpus and the long flexors of the fingers (except the ulnar flexor of the carpus, and part of the deep flexor of the fingers), likewise the outer half of the short muscles of the thumb, and two lumbricales. Median nerve supplies pronators and flexors, and skin of hand.

Some similarity will be observed between the course and distribution of the median and ulnar nerves. Neither gives any offset in the arm. Together they supply all the muscles in front of the fore arm and in the hand, and together they supply the skin of the palmar surface of the hand, and impart tactile power to all the fingers. Parallel between median and ulnar nerves.

MUSCULO-SPIRAL NERVE.

The musculo-spiral nerve, the largest offset of the brachial plexus (fig. 201), occupies chiefly the back part of the limb, and supplies nerves to the extensor muscles, as well as, to some extent, to the skin. Size of the nerve.

At its commencement this nerve is placed behind the axillary vessels. In its progress downwards it winds in a spiral manner (whence the distinctive name) from the inner to the outer side of the limb behind the humerus, between the bone and the triceps muscle. On the outer side of the arm the nerve descends in the interval between the supinator longus and brachialis anticus muscles to the outer condyle of the humerus, where it ends by dividing into the radial and posterior interosseous nerves. Position and connections. Divides near bend of elbow.

The branches given from the musculo-spiral nerve in its Branches in upper arm.

and supplies them. In its progress downwards offsets are muscles between which the nerve lies.

Cutaneous palmar branch. *Cutaneous palmar branch.*—This fascia of the fore arm close to the after crossing over that ligament, end the palm about the middle. It cutaneous palmar branch of the ulna some filaments over the ball of the last referred to communicate with off external cutaneous nerve.

THE MEDIAN NERVE IN

Position of nerve in hand. After passing from beneath the carpus, the median nerve is covered and the integument, and rests agai flexor muscles. Somewhat enlarge

Separates into two primary parts. in colour, it here separates into two size. One of these (the external on short muscles of the thumb, and g the thumb and the index finger; supplies the middle finger, and in ring fingers. The branches thus in as below:—

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Some similarity will be observed between the course and distribution of the median and ulnar nerves. Neither gives any offset in the arm. Together they supply all the muscles in front of the fore arm and in the hand, and together they supply the skin of the palmar surface of the hand, and impart tactile power to all the fingers. Parallel between median and ulnar nerves.

MUSCULO-SPIRAL NERVE.

The musculo-spiral nerve, the largest offset of the brachial plexus (fig. 201), occupies chiefly the back part of the limb, and supplies nerves to the extensor muscles, as well as, to some extent, to the skin. Size of the nerve.

At its commencement this nerve is placed behind the axillary vessels. In its progress downwards it winds in a spiral manner (whence the distinctive name) from the inner to the outer side of the limb behind the humerus, between the bone and the triceps muscle. On the outer side of the arm the nerve descends in the interval between the supinator longus and brachialis anticus muscles to the outer condyle of the humerus, where it ends by dividing into the radial and posterior interosseous nerves. Position and connections. Divides near bend of elbow.

The branches given from the musculo-spiral nerve in its Branches in upper arm.

course through the upper arm, are found on the inner side of the humerus, behind that bone, and on the outer side.

Inner set

a. Internal branches.—These consist of muscular and cutaneous branches :—

Fig. 202.*

for triceps muscle.

Muscular branches for the inner and middle heads of the triceps. That for the inner portion of the muscle is long and slender ; it lies by the side of the ulnar nerve, and reaches as far as the lower third of the upper arm.

Internal cutaneous.

The *internal cutaneous* branch of the musculo-spiral nerve (fig. 202,[3]) commonly unites in origin with the preceding. It winds backwards beneath the intercosto-humeral nerve, and after supplying offsets to the skin, ends about two inches from the olecranon ; in some bodies it extends as far as the olecranon. This nerve is accompanied by a small cutaneous artery.

Posterior set.

b. Posterior branches. — Whilst the musculo-spiral nerve is between the triceps muscle and the humerus, it gives off a large fasciculus, which subdivides into muscular branches.

Branches for triceps and anconeus.

These *muscular branches* supply the outer head of the triceps muscle and the anconeus. The *branch* of the *anconeus* is remarkable for its length, being, at the same time, slender ; it descends in the substance of the triceps, to the interval between the outer condyle of the humerus and the olecranon, to terminate in that muscle of the fore arm.

Outer set.

c. External branches.—This series comprises branches to muscles, and long cutaneous branches.

* Plan of the cutaneous nerves of the back of the arm and fore-arm. 1. Supra-acromial branches of the cervical plexus. 2. Cutaneous branches of the circumflex nerve. 3. Internal cutaneous of the musculo-spiral. 4. Intercosto-humeral branches. 5. External cutaneous (inferior) of the musculo-spiral. 6. Ending of the nerve of Wrisberg. 7. Part of the internal cutaneous for the back of the fore arm. 8. Offset from the dorsal branch of the ulnar nerve. 9. Radial nerve. 10. Branch of the musculo-cutaneous for the back of the fore arm.

The Muscular branches supply the supinator longus, extensor carpi radialis longior, (the extensor carpi radialis brevior receiving its nerve from the posterior interosseous,) and in most cases the brachialis anticus. Branches for two muscles of fore arm.

External cutaneous branches.—These are two in number and are disposed as follows:— Two external cutaneous,

The *upper branch*, the smaller of the two, (fig. 200, [2]), is directed downwards to the fore part of the elbow, along the cephalic vein, and distributes filaments to the lower half of the upper arm on the anterior aspect. The *lower branch* extends as far as the wrist (fig. 202, [3]), distributing offsets to the lower half of the arm, and to the fore arm, on their posterior aspect. It appears beneath the integument at the outer side of the arm, about the middle, and passes to the fore arm over the outer side of the bend of the elbow. About the middle of the fore arm it turns from the outer to the posterior aspect of the limb, and is connected near the wrist with a branch of the external cutaneous nerve. upper; lower reaches wrist.

Ending of the nerve.—Of the two nerves which result from the division of the musculo-spiral, one, the radial, is altogether a cutaneous nerve, and the other (posterior interosseous) is the muscular nerve of the back of the fore arm. Primary division of musculo-spiral.

RADIAL NERVE.

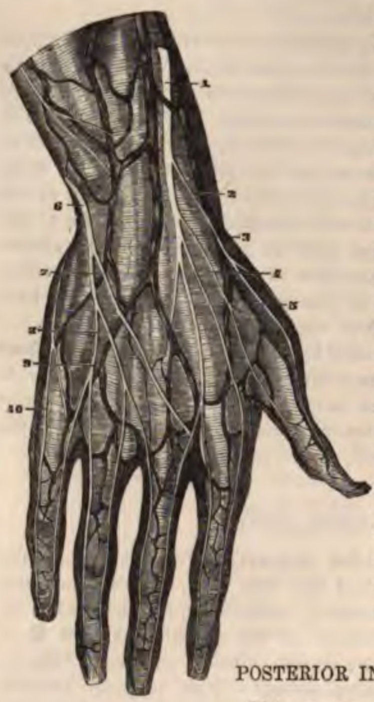
The radial nerve, after separating from the musculo-spiral, is placed in front of the fore arm, close to the outer side, and afterwards turning backwards, is distributed to the integument of the back of the hand. At first it is concealed by the long supinator muscle, and lies a little to the outer side of the radial artery. This position beneath the supinator is retained to about three inches from the lower end of the radius, where the nerve turns backwards beneath the tendon of that muscle, and becomes subcutaneous. Now it separates into two branches, which ramify in the integument over the dorsal aspect of the thumb and the next two fingers (fig. 203, [1]) in the following manner:— Radial a cutaneous nerve. Position, change in. Ending on hand.

One *branch*, the *external* one, extends to the radial side of the thumb, and is joined by an offset of the external cutaneous nerve. It distributes filaments over the ball of the thumb. External branch.

The *internal portion* of the radial nerve communicates Internal branch.

with a branch of the external cutaneous nerve on the back of the fore arm, and joins in an arch on the hand with the dorsal branch of the ulnar nerve. It then divides into digital nerves for the outer fingers.

Fig. 203.*



Digital nerves. *Dorsal digital nerves.*—One of these ramifies on the ulnar side of the thumb, and the second on the radial side of the index finger. The third divides between the opposed sides of the index and middle fingers; and the fourth between the middle and ring fingers. This last branch is connected with a branch of the ulnar nerve. On the sides of the fingers the posterior digital nerves now described join offsets sent backwards from the palmar digital nerves.

POSTERIOR INTEROSSEOUS NERVE.

Posterior interosseous a muscular nerve. This nerve, the larger of the two divisions of the musculo-spiral nerve, winds to the back of the fore arm through the fibres of the supinator brevis muscle, and is prolonged between the deep and superficial layers of the extensor muscles to the interosseous membrane, which it approaches about the middle of the
Course. fore arm.

* A representation of the dorsal nerves of the hand. 1 to 5. Branches of the radial nerve. 6 to 10. Offsets of the dorsal branch of the ulnar nerve. The arrangement here delineated is that attending a larger than usual branch of the ulnar nerve: it is not therefore the one described in the text.

Much diminished in size by the separation of numerous branches for the muscles, the nerve lies at the lower part of the fore arm beneath the extensor of the last phalanx of the thumb, and the tendons of the common extensor of the fingers, and terminates on the back of the carpus in a gangliform enlargement. From this body filaments are given to the ligaments and the articulations on which it rests.

Termination on carpus.

The *branches* of the interosseous nerve enter the surrounding muscles, viz.: the extensor carpi radialis brevis and supinator brevis; the superficial layer of extensor muscles except the anconeus; and the deep layer of the same muscles:—that is to say, the nerve supplies the supinators, and the extensors of the carpus and fingers, with the exception of the supinator longus and the extensor carpi radialis longior.

Supplies extensor muscles and supinator brevis.

Summary of the musculo-spiral nerve.—The trunk of the nerve supplies the extensor muscles of the elbow-joint; and gives a filament to one of the flexors of the same joint (brachialis anticus), but this muscle receives its principal nerves from another source. Before dividing, the nerve gives offsets likewise to two muscles of the fore arm, viz. the long supinator, and the long radial extensor of the carpus. The posterior interosseous division distributes nerves to the remaining muscles on the outer and back part of the fore arm, except the anconeus, viz., to the short supinator and the extensors.

Summary. Nerve supplies extensor and supinator muscles of limb.

Cutaneous nerves are distributed, from the trunk of the nerve and its radial division, to the lower part of the upper arm, to the fore arm, and to the hand—on the posterior and outer aspect of each.

Cutaneous branches.

ANTERIOR PRIMARY BRANCHES OF THE DORSAL NERVES.

These nerves (fig. 205), which from their position with respect to the ribs are named *intercostal*, are twelve in number, and are distributed to the walls of the thorax and abdomen: their connecting cords with the sympathetic nerve are placed in the intercostal spaces, close to the vertebræ.

Intercostal nerves.

Connection with sympathetic.

The intercostal nerves pass separately to their destination, without forming any plexus by the connection or interlacement of their fibres, and in this respect they differ from the anterior branches of the other spinal nerves. From the

Do not form plexus.

Course. Division into two sets.

intervertebral foramina they are directed transversely across the trunk, and nearly parallel one to another. The upper six nerves, with the exception of the first, are confined to the parietes of the thorax; while the lower six nerves are continued from the intercostal spaces to the muscles and integument of the abdomen. This difference in distribution constitutes the ground of the division of the intercostal nerves into two sets.

THE UPPER INTERCOSTAL NERVES.

Upper six (first excepted). Course and connections in intercostal spaces.

In their course to the fore part of the chest, these nerves accompany the intercostal blood-vessels. After a short space they pass between the strata of the intercostal muscles, and, about midway between the vertebræ and the sternum, give off the lateral cutaneous branches. The nerves are now continued forwards amid the fibres of the internal intercostal muscles as far as the costal cartilages, where they come into contact with the pleura. In approaching the sternum, they cross the internal mammary artery and the fibres of the triangularis sterni muscle. Finally, these nerves pierce the internal intercostal muscle and the greater pectoral, and end in the integument under the name of the anterior cutaneous nerves of the thorax.

Become subcutaneous at the sternum.

Branches.

Branches.—Besides the cutaneous nerves (two sets) already indicated, many branches are distributed from the intercostal nerves to the neighbouring muscles. The several offsets require separate notice.

Lateral cutaneous nerves.

The *lateral cutaneous nerves of the thorax* (fig. 204) pierce the external intercostal and serratus magnus muscles, in a line a little behind the level of the great pectoral muscle. Each of these nerves, except that from the second intercostal, (the first intercostal nerve has already been excluded from the general account of these nerves), divides into two branches, which reach the integument at a short distance from each other, and taking opposite directions, the one forwards the other backwards, are named anterior and posterior.

Division into two branches.

Anterior branches.

The *anterior branches*,[2], are continued forwards to where those cutaneous nerves end, that are reflected outwards from the fore part of the thorax. Several of these branches reach the mammary gland and the nipple; and from the lower nerves offsets are supplied to the digitations of the external oblique muscle of the abdomen.

Posterior branches.

The *posterior branches*,[3], turn backwards to the integu-

ment over the scapula and the latissimus dorsi muscle. That derived from the second intercostal nerve is the largest of these branches, and ends in the skin of the arm; it will be presently noticed under the name "intercosto-humeral nerve." The branch from the third nerve ramifies in the axillary space, and a few filaments likewise reach the arm.

Fig. 204.*

Anterior cutaneous nerves:

The *anterior cutaneous nerves of the thorax*,[1], (reflected nerves,—A. Cooper,) which are the terminal twigs of the intercostal nerves, are reflected outwards in the integument over the great pectoral muscle. The branch from the second nerve is connected with the supraclavicular and the lateral cutaneous nerves; those from the third and fourth nerves are distributed to the mammary gland.

branches to mammary gland.

Muscular branches. — Numerous filaments, which are usually slender and of various lengths, are supplied to the intercostal muscles, and the triangularis sterni. At the anterior part of the chest some of these branches cross the cartilages of the ribs, passing from one intercostal space to another.

Muscular.

PECULIARITIES OF CERTAIN DORSAL NERVES.

FIRST DORSAL NERVE.

The anterior branch of this nerve enters almost wholly into the brachial plexus. Usually it does not supply a

First dorsal joins brachial plexus.

* Plan of the cutaneous nerves of the chest and abdomen (altered from a plate of M. Bourgery). *a.* Section of the arm. *b.* Pectoral muscle. *c.* Latissimus dorsi. *d.* External oblique. *e.* Serratus magnus. 1, 1, 1. Anterior cutaneous nerves of the chest and belly. 2, 2, 2. Anterior branches of the lateral cutaneous nerves of the chest and belly. 3, 3, 3. Posterior branches of the same. 4, 4, 4. Cutaneous branches from the posterior divisions of the lumbar nerves. 5. Ilio-hypogastric. 6. Small occipital nerve.

No lateral cutaneous branch. lateral cutaneous branch; but when the cutaneous offset ordinarily given from the second dorsal nerve is wanting (intercosto-humeral nerve), a branch from the first takes its place. Before emerging from the thorax to join the brachial plexus, this nerve gives off a small *intercostal branch*, which courses along the first intercostal space, in the manner of the other intercostal nerves. From this branch is derived the first of the anterior cutaneous nerves of the thorax: this cutaneous nerve, however, is wanting in some cases.

Gives a small intercostal nerve.

Anterior cutaneous.

SECOND INTERCOSTAL NERVE.

Second nerve.

The second intercostal nerve differs from the rest chiefly in the size of its lateral cutaneous branch. This branch is the largest of the series of lateral cutaneous nerves: it commonly wants the anterior division, and the posterior one is distributed to the skin of the arm, under the name intercosto-humeral nerve.

Large lateral cutaneous branch.

Intercosto-humeral.

The *intercosto-humeral* nerve, proceeding from the source just indicated, crosses the axillary space to reach the arm, and is connected in the axilla with an offset of the nerve of Wrisberg. Penetrating the fascia, it becomes subcutaneous, and ramifies in the integument of the upper half of the arm, on the inner and posterior aspect (fig. 202,[4]): a few filaments reach the integument over the scapula. The branches of this nerve cross over the internal cutaneous offset of the musculo-spiral nerve, and a communication is established between the two.—The size of the intercosto-humeral nerve (and the same may be said of the extent to which it supplies the integument) is in the inverse proportion to the size of the other cutaneous nerves of the upper arm, especially the nerve of Wrisberg (p. 611).

Connection with nerve of Wrisberg.

Ending.

THE LOWER INTERCOSTAL NERVES.

Nerves at first between ribs, then between abdominal muscles.

The lower intercostal nerves, with the exception of the last, pass through the intercostal spaces (fig. 205); and in this part of their course they have the same arrangement as the nerves of the upper series. From the anterior ends of the intercostal spaces they are continued between the internal oblique and the transverse muscle of the abdomen to the outer edge of the rectus. Perforating the sheath,

they then enter the substance of this muscle, and terminate in small cutaneous branches (anterior cutaneous).

Branches.

These nerves supply the intercostal and abdominal muscles, and they are connected one with another between the muscles of the abdomen. About the middle of their course, offsets (lateral cutaneous nerves of the abdomen) are transmitted to the integument as from the upper intercostal nerves.

Fig. 205.*

Lateral cutaneous nerves;

The *lateral cutaneous nerves of the abdomen* (fig. 204) pass to the integument through the external intercostal, and external oblique muscles, in a line with the corresponding nerves on the thorax, and divide in the same manner into anterior and posterior branches.

their anterior, and

The *anterior branches* are the larger, and are directed inwards in the superficial fascia, with small cutaneous arteries, nearly to the edge of the rectus muscle.

posterior branches.

The *posterior branches* bend backwards over the latissimus dorsi muscle, and extend towards the cutaneous nerves of the back.

Anterior cutaneous nerves.

The *anterior cutaneous nerves*† *of the abdomen* become subcutaneous near the linea alba, with small perforating arteries. Their number and position are very uncertain. They are directed outwards towards the lateral cutaneous nerves (fig. 204).

LAST DORSAL NERVE.

Last dorsal

The anterior primary branch of this nerve is below the

* Plan of the intercostal nerves (altered from Bourgery). *a.* Cut surface of the arm. *b.* Pectoralis minor muscle. *c.* Serratus magnus muscle. *d.* Subscapular muscle. *f.* Transverse muscle of the abdomen. 1, 1, 1, 1. Anterior cutaneous nerves of the thorax and abdomen. 2. Posterior thoracic nerve. 3, 3, 3. Intercostal nerves. 4. Lateral cutaneous branch of the last dorsal nerve.

† A second set of anterior cutaneous branches is described by Professor Cruveilhier as existing at the outer edge of the rectus muscle.

is below the last rib.

last rib, and is contained altogether in the abdominal wall. The nerve has the general course and distribution of the others between the internal oblique and transversalis, but before taking its place between those muscles, it crosses the upper part of the quadratus lumborum, and pierces the posterior aponeurosis of the transverse muscle (lumbar fascia). This nerve is connected by offsets with the nerve above, and occasionally with the ilio-hypogastric branch of the lumbar plexus. Near the spine it sometimes communicates with the first lumbar nerve by means of a small cord (dorsi-lumbar) in the substance of the quadratus lumborum.

Lateral cutaneous branch over gluteal region.

The *lateral cutaneous branch* of the last dorsal nerve (fig. 205,[4],) becomes subcutaneous by passing through both oblique muscles: it is then directed downwards over the iliac crest to the integument covering the fore part of the gluteal region and the upper and outer part of the thigh, some filaments reaching as far as the great trochanter of the femur.

ANTERIOR PRIMARY BRANCHES OF THE LUMBAR NERVES.

Four go to form lumbar plexus.

The anterior branches of the lumbar nerves increase in size from the first to the fifth; and all, except the fifth, besides giving off branches outwards, are connected together by anastomotic loops, so as to form the lumbar plexus. On leaving the intervertebral foramina these nerves are connected by filaments with the sympathetic nerve, and the filaments are longer than those connected with other spinal nerves, in consequence of the position of the lumbar sympathetic ganglia on the fore part of the bodies of the vertebræ. In the same situation small twigs are furnished to the psoas and quadratus lumborum muscles.

Connection with sympathetic.

Twigs to psoas and quadratus.

The fifth, with part of fourth, joins the sacral plexus.

The anterior branch of the fifth lumbar nerve, as just stated, does not enter into the lumbar plexus. Having received a fasciculus from the nerve next above it, it descends to join the first sacral nerve, and thus forms part of the sacral plexus. The cord resulting from the union of the fifth with a part of the fourth nerve, is named the *lumbo-sacral* nerve.

Lumbo-sacral cord.

SUPERIOR GLUTEAL NERVE.

Superior gluteal

Before joining the first sacral nerve the lumbro-sacral cord

gives off from behind the superior gluteal nerve; this offset leaves the pelvis through the large sacro-sciatic foramen, above the pyriformis muscle, and divides like the gluteal artery into two branches, which are distributed chiefly to the smaller gluteal muscles.

The *upper* branch runs with the gluteal artery along the origin of the gluteus minimus, and is lost in it, and in the gluteus medius. The *lower* branch crosses over the middle of the gluteus minimus, between this and the gluteus medius, and supplying filaments to both those muscles, is continued forwards, and terminates in the tensor muscle of the fascia lata.

supplies glutei and tensor fasciæ latæ.

LUMBAR PLEXUS.

Lumbar plexus.

The lumbar plexus is formed by the communications between the anterior primary branches of the four upper lumbar nerves. It is placed in the substance of the psoas muscle, in front of the transverse processes of the corresponding vertebræ. Above, the plexus is narrow, and is sometimes connected with the last dorsal nerve by a small offset named dorsi-lumbar; below it is wider, and is joined to the sacral plexus by means of the lumbo-sacral nerve.

Construction of the plexus and origin of branches.

The arrangement of the nerves constituting the plexus, and the mode of origin of its several branches, may be thus stated:—The first nerve gives off the ilio-hypogastric and ilio-inguinal nerves, and sends downwards a communicating branch to the second nerve. The second furnishes the genito-crural and external cutaneous nerves, and gives a connecting branch to the third. From the third nerve, besides the descending branch to the fourth, two branches proceed: one of these, the larger, forms part of the anterior crural nerve; the other, a part of the obturator nerve. The fourth nerve sends two branches, which serve to complete the obturator and anterior crural nerves, and a connecting branch to the fifth nerve. The fifth, with the connecting branch just mentioned, is the lumbro-sacral nerve already described.

Branches supply abdominal wall and lower limb.

The *branches* of this plexus form two sets, which are distributed, one to the lower part of the wall of the abdomen, the other to the fore part and inner side of the lower limb. In the former set are the ilio-hypogastric and ilio-inguinal nerves, and part of the genito-crural; and to the latter belong the remaining part of the genito-crural nerve,

the external cutaneous, the obturator, and the anterior crural nerves.

ILIO-HYPOGASTRIC AND ILIO-INGUINAL NERVES.

Abdominal branches. The upper two branches from the lumbar plexus, viz

Fig. 206.*

the ilio-hypogastric and ilio-inguinal (superior and middle

* The lumbar plexus and its branches (slightly altered from Schmidt). *a*. Last rib. *b*. Quadratus lumborum muscle. *c*. Oblique and transverse muscles, cut near the crest of the ilium. *d*. Pubes. *e*. Adductor brevis muscle. *f*. Pectineus. *g*. Adductor longus. 1. Ilio-hypogastric branch. 2. Ilio-inguinal. 3. External cutaneous branch. 4. Anterior crural nerve. 5. Accessory obturator. 6. Obturator nerve. 7. Genito-crural nerve divided into two at its origin from the plexus. 8. Gangliated cord of the sympathetic nerve.

musculo-cutaneous,—Bichat), are both derived from the first lumbar nerve, and are destined to supply nearly similar parts. They become subcutaneous by passing between and then through the broad muscles of the abdomen, and end in the integument of the groin and scrotum (or labia pudendi), as well as in that covering the gluteal muscles. In the relative size of these two nerves a principle of compensation is observed to exist,—the extent of distribution of the one being inversely to the extent of the other. The two upper ones have a similar course.

The *ilio-hypogastric* nerve (fig. 206,[1]) passes from the cavity to the wall of the abdomen, in which it is placed between the muscles, and ends beneath the skin. Emerging from the upper part of the psoas muscle at the outer border, it runs obliquely over the quadratus lumborum to the iliac crest; and there perforating the transverse muscle of the abdomen, gets between that muscle and the internal oblique, and divides into an iliac and a hypogastric branch. Ilio-hypogastric nerve, its course.

The *iliac branch* pierces the attachment of both oblique muscles, immediately above the iliac crest, and is lost in the integument over the gluteal muscles,—behind the distribution of the lateral cutaneous branch of the last dorsal nerve. Iliac branch.

The *hypogastric* or *abdominal* branch continues on between the transverse and internal oblique muscles, and is connected with the ilio-inguinal nerve near the iliac crest. It then perforates in succession both the oblique muscles, passing through the external oblique near the pubes, and not far from the middle line. Having become subcutaneous, this branch is distributed to the skin over the hypogastric region (fig. 208,[1]). Hypogastric or abdominal branch.

The size of the iliac branch of this nerve varies according to that of the lateral cutaneous branch of the twelfth dorsal. The hypogastric branch is not unfrequently joined with the last dorsal nerve between the muscles, and near the crest of the innominate bone. Difference in size.

The *ilio-inguinal nerve*, (fig. 206,[2]), (inferior musculo-cutaneous,—Bichat,) smaller than the preceding, with which it has a common origin from the first lumbar nerve, supplies the integument of the groin. It descends obliquely outwards over the quadratus lumborum, and then over the iliacus muscle. In this part of its course, the nerve is placed lower down than the ilio-hypogastric; and having perforated the transverse muscle further forwards than that Ilio-inguinal nerve. Crosses quadratus lumborum and iliacus.

Perforates abdominal muscles.

nerve, communicates with it between the abdominal muscles, near the anterior end of the iliac crest. Passing through the fleshy part of the internal oblique muscle, and afterwards through the external abdominal ring, the ilio-inguinal nerve becomes subcutaneous (fig. 208,[2]), and is distributed to the skin upon the groin, as well as to that upon the scrotum and penis in the male, or the labium pudendi in the female, communicating with the inferior pudendal nerve. In its progress this nerve furnishes branches to the internal oblique muscle.

Ends in skin.

Muscular branches.

Varies in origin and size.

The ilio-inguinal nerve occasionally arises from the loop connecting the first and second lumbar nerves. It is sometimes small, and ends near the iliac crest by joining the ilio-hypogastric nerve; in that case the last nerve gives off an inguinal branch, having a similar course and distribution to the ilio-inguinal nerve, the place of which it supplies.

GENITO-CRURAL NERVE.

Genito-crural nerve.

The genito-crural nerve (Bichat), (fig. 206,[7]), as its name implies, belongs partly to the external genital organs and partly to the thigh. It is derived chiefly from the second lumbar nerve, but receives also a few fibres from the connecting cord between that and the first nerve. The nerve descends obliquely through and afterwards on the fore part of the psoas muscle towards Poupart's ligament, dividing at a variable height into an internal or genital, and an external or crural branch.*

In front of psoas.

Two branches.

Its genital branch.

The *genital branch* lies upon or near the external iliac artery, and sends filaments on that vessel; then perforating the transversalis fascia, it passes through the inguinal canal with the spermatic cord, and is lost upon the cremaster muscle. In the female it accompanies the round ligament of the uterus.

Supplies cremaster.

Its crural branch.

The *crural branch* descends upon the psoas muscle beneath Poupart's ligament into the thigh. Immediately below that ligament, and at the outer side of the femoral artery, it pierces the fascia lata (fig. 208,[7]); having become subcutaneous, it supplies the skin on the upper part of the thigh, and communicates with the middle cutaneous branch of the anterior crural nerve. Whilst it is passing beneath

* This nerve often bifurcates close to its origin from the plexus, in which case its two branches perforate the psoas muscle in different places. Schmidt describes them as separate nerves, naming the genital branch, external spermatic, and the crural branch, lumbo-inguinal.

Poupart's ligament, some filaments are prolonged from this nerve on to the femoral artery.*

EXTERNAL CUTANEOUS NERVE.

This nerve (fig. 206,[3]) descends through the lower part of the abdomen, and ends in the integument upon the outer side of the thigh (fig. 207,[1]). External cutaneous nerve;

Commencing from the loop formed between the second and third lumbar nerves, it reaches the surface of the psoas muscle about the middle of the outer border. Thence it is directed across the iliacus muscle to the notch beneath the anterior-superior iliac spine, where it escapes from the abdomen by passing beneath Poupart's ligament to the thigh. passes beneath iliac spine.

One of its offsets, the *posterior branch*, perforates the fascia lata, and subdivides into two or three others, which turn backwards and supply the skin upon the outer surface of the limb, from the upper border of the hip-bone nearly to the middle of the thigh ; the highest among the branches are crossed by the cutaneous branches from the last dorsal nerve. Branches: a posterior

An *anterior branch*, the continuation of the nerve, is at first contained in a sheath or canal formed in the substance of the fascia lata ; but about four inches below Poupart's ligament, it enters the subcutaneous fatty tissue, and descends beneath the skin along the outer part of the front of the thigh, giving off branches in its course, and ending near the knee. The principal offsets are those springing from its outer side. and an anterior one.

The two branches of the external cutaneous nerve communicate with each other at the upper part of the thigh ; and, in some cases, the anterior branch reaches quite down to the knee, and communicates there with the internal saphenous nerve. Communications with other nerves.

OBTURATOR NERVE.

The obturator nerve (internal crural), (fig. 206,[6]), is distributed to the adductor muscles of the thigh, and to the hip and knee joints. Obturator nerve.

* It is stated by Schmidt, that when the crural branch of the genito-crural nerve is large, and commences near the plexus, he has observed it to give a muscular branch to the lower border of the internal oblique and transversalis muscles.

Fig. 207.*

ANTERIOR CRURAL NERVE.

Anterior crural nerve,

This nerve (fig. 206,[4]) supplies the muscles which extend the knee, and sends cutaneous branches to the fore part of the thigh, and the inner side of the leg.

is largest of all.

It is the largest branch of the lumbar plexus, and is derived in part from the second, but principally from the third and fourth lumbar nerves.

Origin from plexus.

Situate at first, like the other branches of this plexus, among the fibres of the psoas, it emerges from the outer border of that muscle near the lower part, and is then lodged between the psoas and iliacus muscles, in which position it descends beneath Poupart's ligament into the thigh.

On the thigh,

On the thigh (fig. 207) the anterior crural nerve is placed deeply between the psoas and iliacus muscles, about a quarter of an inch to the outer side of the femoral artery, and soon becoming flattened out, divides into two parts, of which one is superficial and furnishes cutaneous branches, while the other (the deep, or posterior part,) is distributed to muscles. In some cases, it is found to divide into four instead of two parts.

divides into two sets of branches.

Its branches in the abdomen.

Branches of the trunk. — The branches given from the anterior crural nerve within the abdomen are few and of small size. Some supply

* Plan of nerves given from the lumbar plexus to the lower limb. 1. External cutaneous nerve. 2, 3. Branches of the same. 4. Anterior crural nerve. 5, 6. Middle cutaneous. 7. Internal cutaneous (anterior portion). 8. Long saphenous nerve. 9, 10. Muscular branches. 12. Cutaneous branch of the musculo-cutaneous nerve of the leg. 13. Anterior tibial.

of which enter those muscles, excepting one which is prolonged downwards to the knee-joint.

Branches.—The *muscular* branches supply the external obturator and the great adductor muscle, with also the short adductor when this muscle receives no offset from the anterior division of the nerve. **Branches for muscles.**

The *articular* branch for the knee rests at first on the adductor magnus, but perforates the lower fibres of that muscle, and thus reaches the upper part of the popliteal space. Supported by the popliteal artery, and sending filaments around that vessel, the nerve then descends to the back of the knee-joint, and enters the articulation through the posterior ligament.* **Branch for knee-joint.**

ACCESSORY OBTURATOR NERVE.

The accessory obturator nerve (nervus ad obturatorem accessorius, inconstans—Schmidt), a small and inconstant nerve,† communicates with the obturator nerve in the thigh, and is distributed to the hip-joint (fig. 206,[5]). **Accessory obturator is inconstant.**

Arising from the obturator nerve near its upper end, or from the third and fourth lumbar nerves, this accessory nerve descends beneath the fascia along the inner border of the psoas muscle, as far as the pubes, beyond which it gets behind the pectineus muscle, and ends by dividing into several branches. Of these one joins the anterior branch of the obturator nerve; another penetrates the pectineus on the under surface; whilst a third enters the hip-joint with the articular artery. **Origin.** **Supplies muscles and hip-joint;**

This nerve is sometimes small, and ends in filaments which lie upon and perforate the fibrous capsule of the hip-joint. When it is altogether wanting, the hip-joint receives branches from the obturator nerve itself. **may be absent.**

Summary.—The obturator nerve and its accessory give branches to the hip and knee joints, also to the adductor muscles of the thigh, and, in some cases, to the pectineus. Occasionally a cutaneous branch descends to the inner side of the thigh, and to the inner and upper part of the leg. **Summary.**

* See a paper by Dr. A. Thomson, London Med. and Surg. Journal, No. xcv.

† Schmidt states that he found this nerve 'four or five times in nine or ten bodies.'—"Commentar. de Nervis lumbalibus," § xl.

Fig. 207.*

ANTERIOR CRURAL NERVE.

Anterior crural nerve,

This nerve (fig. 206,[4]) supplies the muscles which extend the knee, and sends cutaneous branches to the fore part of the thigh, and the inner side of the leg.

is largest of all.

It is the largest branch of the lumbar plexus, and is derived in part from the second, but principally from the third and fourth lumbar nerves.

Origin from plexus.

Situate at first, like the other branches of this plexus, among the fibres of the psoas, it emerges from the outer border of that muscle near the lower part, and is then lodged between the psoas and iliacus muscles, in which position it descends beneath Poupart's ligament into the thigh.

On the thigh,

On the thigh (fig. 207) the anterior crural nerve is placed deeply between the psoas and iliacus muscles, about a quarter of an inch to the outer side of the femoral artery, and soon becoming flattened out, divides into two parts, of which one is superficial and furnishes cutaneous branches, while the other (the deep, or posterior part,) is distributed to muscles. In some cases, it is found to divide into four instead of two parts.

divides into two sets of branches.

Its branches in the abdomen.

Branches of the trunk. — The branches given from the anterior crural nerve within the abdomen are few and of small size. Some supply

* Plan of nerves given from the lumbar plexus to the lower limb. 1. External cutaneous nerve. 2, 3. Branches of the same. 4. Anterior crural nerve. 5, 6. Middle cutaneous. 7. Internal cutaneous (anterior portion). 8. Long saphenous nerve. 9, 10. Muscular branches. 12. Cutaneous branch of the musculo-cutaneous nerve of the leg. 13. Anterior tibial.

the iliacus muscle, and one ramifies over the femoral artery.

The *iliacus* receives three or four small branches, which are directed outwards from the nerve to the fore part of the muscle. For iliacus muscle.

The *nerve of the femoral artery* (nerv. arteriæ crurali proprius,—Schmidt,) divides into numerous filaments upon the upper part of that vessel. On femoral artery.

This small branch varies somewhat in its origin: it sometimes arises lower down than usual in the thigh: it may, on the other hand, be found to take origin above the ordinary position, and in this case it proceeds from the middle cutaneous nerve when that branch springs from or near the lumbar plexus. In either case, its ultimate distribution is the same as that already described. Origin varies.

Terminal branches.—From the principal or terminal divisions of the nerve the remaining branches take their rise as follows:—

From the SUPERFICIAL PART cutaneous branches are given to the fore part of the thigh, and to the inner side of the leg. They are the middle and internal cutaneous nerves, and the internal saphenous nerve. One of the muscles (the sartorius) receives its nerves from this series. Superficial part gives cutaneous branches.

MIDDLE CUTANEOUS NERVE.

The middle cutaneous nerve (fig. 208) may pierce the fascia lata as two branches about three inches below Poupart's ligament, or as one trunk which soon divides into two branches,[4]. The two nerves resulting from the division descend side by side beneath the integument on the fore part of the thigh to the inner side and front of the patella: they give off on each side numerous offsets to the skin. After or before the nerve has become subcutaneous, it communicates with the crural branch of the genito-crural nerve, and also with the succeeding nerve, the internal cutaneous. Middle cutaneous nerve. Distribution: joins others.

This nerve sometimes arises from the anterior crural, high up within the abdomen. Varies in origin.

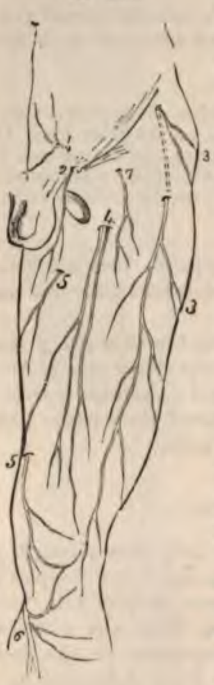
INTERNAL CUTANEOUS NERVE.

The internal cutaneous nerve (fig. 208,[5]) gives branches to the skin on the inner side of the thigh, and the upper part of the leg; but the extent to which it reaches depends upon Internal cutaneous nerve;

the presence of the 'occasional cutaneous' branch of the obturator nerve.

its course. This nerve lying beneath the fascia lata, descends obliquely over the upper part of the femoral artery. Division. It divides either in front of that vessel, or at the inner side, into two branches (one anterior, the other internal), which pierce the fascia separately. These two branches sometimes arise as distinct offsets from the superficial part of the anterior crural nerve.

Fig. 208.*



Small cutaneous branches in the thigh. *Offsets of the internal cutaneous nerve.*—Previously to dividing into its two ultimate branches, this nerve gives off two or three cutaneous twigs, which accompany the upper part of the long saphenous vein. The highest of these perforates the fascia near the saphenous opening, and reaches down to the middle of the thigh. The others appear beneath the skin lower down by the side of the vein : one, larger than the rest, passes through the fascia about the middle of the thigh, and extends to the knee.—In some instances, these small offsets spring directly from the anterior crural nerve, and they often communicate with each other.

Terminal branches. The two *terminal branches* of the nerve are disposed as follows;—

Anterior; The *anterior branch*,[5], descending in a straight line to the knee, perforates the fascia lata in the lower part of the thigh, and afterwards runs down near the intermuscular septum, giving off filaments on each side to the skin, and it is finally directed over the patella to the outer side of the knee. It communicates above the joint

* Plan of the cutaneous nerves on the front of the thigh. 1. Ilio-hypogastric branch. 2. Ilio-inguinal branch. 3, 3. Branches of external cutaneous nerve. 4. Branches of middle cutaneous nerve. 5, 5. Internal cutaneous: the lower number refers to the anterior division of this nerve. 6. Internal saphenous nerve, when become subcutaneous. 7. Crural branch of the genito-crural nerve.

with a branch of the long saphenous nerve; and sometimes it takes the place of the branch usually given by the latter to the integument over the patella.

This branch of the internal cutaneous nerve sometimes lies above the fascia in its whole length. It occasionally gives off a cutaneous filament, which accompanies the long saphenous vein, and in some cases it communicates with the branch to be next described. varies in position. Occasional offsets.

The *inner branch* of the internal cutaneous nerve descends along the posterior border of the sartorius muscle to the inner side of the knee (fig. 210,[1]), where it perforates the fascia lata, and communicates by a small branch with the internal saphenous nerve, which here descends in front of it. Having given off some cutaneous filaments to the lower part of the thigh on the inner side, the nerve is continued downwards to be distributed to the skin upon the inner side of the leg. Whilst beneath the fascia, this branch of the internal cutaneous nerve joins in an interlacement with offsets of the obturator nerve below the middle of the thigh, and with the branch of the saphenous nerve nearer the knee. The inner branch, ends on the leg; forms an interlacement with other nerves.

Where the communicating branch of the obturator nerve, just referred to, is of large size, and is continued to the skin of the leg, the internal cutaneous nerve does not reach beyond the interlacement of nerves in which it has been stated to take part; occasionally, however, a few filaments are found to reach as far as the knee. Cutaneous branch sometimes wanting.

INTERNAL SAPHENOUS NERVE.

The internal or long saphenous nerve (fig. 207,[5]), which supplies in part the skin upon the thigh and leg, is the largest of the cutaneous branches of the anterior crural nerve. In some cases it arises in connection with one of the deep or muscular branches. Internal saphenous nerve.

This nerve is deeply placed as far as the knee, and is subcutaneous in the rest of its course. In the thigh it accompanies the femoral vessels, lying at first somewhat to their outer side, but lower down approaching close to them, and passing beneath the same aponeurosis. When the vessels pass through the opening in the adductor muscle into the popliteal space, the saphenous nerve separates from them, and is continued downwards beneath the sartorius muscle to the inner side of the knee; where, having first given off, as it lies near the inner condyle of the femur, a branch which is distributed over the front of the patella, it becomes Course in the thigh. Position at the knee.

subcutaneous by piercing the fascia between the tendons of the sartorius and gracilis muscles.

Course in the leg.

When subcutaneous, the nerve accompanies the saphenous vein along the inner side of the leg down to the foot (fig. 211,[1]). The position it bears with regard to the vein is liable to variation. It may be described as descending behind the inner border of the tibia, and dividing into two branches about the lower third of the leg. One of these follows the margin of the tibia, and terminates near the inner ankle; whilst the other and larger branch accompanies the vein in front of the ankle, and ends in the integument on the inner side of the foot. Some filaments are found to enter the tarsal ligaments.

Interlacement with other nerves.

Branches.—About the middle of the thigh, the saphenous nerve gives off a *communicating branch* to join in the interlacement already noticed as formed beneath the fascia lata by this nerve and branches of the obturator and internal cutaneous nerves. After it has left the aponeurotic covering of the femoral vessels, the internal saphenous nerve has, in some cases, a further connection with one or other of the nerves just referred to.

Branch to skin in front of patella.

The branch given to the *integument in front of the patella* perforates the sartorius muscle and the fascia lata; and, having received a communicating offset from the internal cutaneous nerve, divides into many filaments, which spread out upon the fore part of the knee. Some of these descend, and are connected with other branches of the saphenous nerve below the knee; others turn outwards, and, by uniting with branches of the middle and external cutaneous nerves, form a plexus—plexus patellæ.

Plexus patellæ.

Nerve in leg.

Besides the communications already mentioned, the long saphenous nerve is connected in the leg with the cutaneous branch derived from the internal cutaneous nerve.

Place taken by internal cutaneous.

In some bodies the last-described branch is very small, and ends by joining the internal cutaneous nerve, which, in that case, supplies its place on the front of the knee-joint.

Deep branches of crural nerve.

The DEEP SERIES of the branches of the anterior crural nerve supply the muscles on the fore part of the thigh, and also one of those on the inner side, viz. the pectineus. They may be thus described.

MUSCULAR BRANCHES.

To pectineus;

The branch to the *pectineus* muscle (which sometimes forms

one of the anterior series) crosses inwards behind the femoral vessels, and enters the muscle on the anterior aspect.

The *sartorius* muscle receives three or four twigs, which arise in common with the cutaneous nerves, and reach mostly the upper part of the muscle. to sartorius

The *rectus* muscle receives a distinct branch on its under surface. to rectus;

The nerve for the *vastus externus*, of considerable size, descends with the branches of the external circumflex artery towards the lower part of the muscle. It gives off a long slender *articular* filament, which reaches the knee, and penetrates the fibrous capsule of the joint. to vastus externus; gives articular branch;

Another large branch divides into two sets, which enter the *vastus internus* and the *crureus* about the middle of those muscles. The nerve of the vastus internus (sometimes inaptly named the short saphenous nerve), before penetrating the muscular fasciculi, gives a small offset to the knee-joint. to crureus and interna vastus;

This *articular* nerve passes along the internal intermuscular septum with a branch of the anastomotic artery, as far as the inner side of the joint, where it perforates the capsular ligament, and is directed outwards on the synovial membrane beneath the ligamentum patéllæ. an articular nerve to knee.

Summary.—The anterior crural nerve is distributed to the skin upon the fore part and inner side of the thigh, commencing below the termination of the ilio-inguinal and genito-crural nerves. It furnishes also a cutaneous nerve to the inner side of the leg and foot. Summary. Cutaneous branches.

All the muscles on the front and outer side of the thigh receive their nerves from the anterior crural, and one of the muscles on the inner side of the limb (the pectineus) is also in part supplied by this nerve.—The tensor muscle of the fascia lata is supplied from a different source, viz. the superior gluteal nerve. Muscular branches.

Lastly, two branches are given from the same nerve to the knee-joint. Articular branches.

ANTERIOR PRIMARY BRANCHES OF THE SACRAL AND COCCYGEAL NERVES.

THE SACRAL NERVES.

The anterior branches of the first four of these nerves emerge through the anterior sacral foramina, and the fifth escapes from the spinal canal between the sacrum and coccyx. Number of nerves. Exit from sacral canal;

their size; The first two of the sacral nerves are of large and about equal size, the others diminish rapidly, and the fifth is exceedingly slender. Like the corresponding divisions of the other spinal nerves, the anterior branches of the sacral nerves communicate with the sympathetic nerve; the communicating cords are however very short, as the ganglia of the latter are close to the inner margin of the foramina of the sacrum.

join sympathetic;

outline of their arrangement. The first four nerves (the fourth in part) contribute to form the sacral plexus. The fifth has no share in the plexus, —it ends on the back of the coccyx. The fourth and fifth nerves have therefore some peculiarities in the manner of their distribution: and, as the description will occupy but a short space, these two nerves will be noticed first, before the detail of the other nerves, and the numerous branches to which they give rise, are followed out.

THE FOURTH SACRAL NERVE.

Fourth nerve joins plexus, and gives branches. Only one part of the anterior division of this nerve joins the sacral plexus; the remainder, which is nearly half the nerve, supplies branches to the viscera and muscles of the pelvis, and sends downwards a connecting filament along the side of the coccyx to the fifth nerve.

Visceral branches. The *visceral branches* of the fourth sacral nerve are directed forwards to the lower part of the bladder, and communicate freely with branches from the sympathetic nerve. Offsets are distributed to the neighbouring viscera, according to the sex; they will be described with the pelvic portion of the sympathetic nerve.—The foregoing branches are, in some instances, furnished by the third sacral nerve instead of the fourth.

Muscular branches. Of the *muscular branches*, one supplies the *levator ani*, piercing that muscle on the pelvic surface; another enters the *coccygeus*; whilst a third ends in the *external sphincter* muscle of the rectum. The last branch, after passing either through the coccygeus, or between it and the levator ani, reaches the perinæum, and is distributed likewise to the integuments between the anus and the coccyx.

THE FIFTH SACRAL NERVE.

Fifth nerve; The anterior branch of this, the lowest sacral nerve, comes forwards through the coccygeus muscle opposite the junction

of the sacrum with the first coccygeal vertebra;* it then descends upon the coccygeus nearly to the tip of the coccyx, where it turns backwards through the fibres of that muscle, and ends in the integument upon the posterior and lateral aspect of the bone. ends in teguments.

As soon as this nerve appears in front of the bone (in the pelvis) it is joined by the descending filament from the fourth nerve, and lower down by the small anterior division of the coccygeal nerve. It supplies small filaments to the coccygeus muscle. Branches, and union with others.

THE COCCYGEAL NERVE.

The anterior branch of the coccygeal, or, as it is sometimes named, the sixth sacral nerve, is a very small filament. It escapes from the spinal canal by the terminal opening, pierces the sacro-sciatic ligament and the coccygeus muscle, and being joined upon the side of the coccyx with the fifth sacral nerve, partakes in the distribution of that nerve. Coccygeal nerve joins last sacral.

THE SACRAL PLEXUS.

The lumbo-sacral cord (formed as before described by the junction of the fifth and part of the fourth lumbar nerves), the anterior divisions of the first three sacral nerves, and part of the fourth, unite to form this plexus. Sacral plexus; nerves forming it. Its construction differs from that of any other of the plexuses formed by the spinal nerves, as the several constituent nerves entering into it unite into one broad flat cord. Peculiar construction of plexus; To the place of union the nerves proceed in different directions, the upper ones being very oblique, while the lower are nearly horizontal in their course; and, as a consequence of this difference in direction, they diminish in length from the first to the last. The sacral plexus, thus constructed, rests on the anterior surface of the pyriform muscle, opposite the side of the sacrum. its connections; It is broadest at the upper part, where the nerves join, and narrow at the lower end, where it escapes through the great sacro-sciatic foramen; and it is continued into or ends in the great sciatic nerve. ends in sciatic nerves.

Branches.—The sacral plexus supplies the larger part of the nerves of the lower limb, and furnishes some small Outline of branches.

* The nerve occasionally passes through a foramen (fifth sacral) formed between the sacrum and the coccyx.

their size ; The first two of the sacral nerves are of large and about equal size, the others diminish rapidly, and the fifth is exceedingly slender. Like the corresponding divisions of the other spinal nerves, the anterior branches of the sacral nerves communicate with the sympathetic nerve ; the communicating cords are however very short, as the ganglia of the latter are close to the inner margin of the foramina of the sacrum.

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THE FIFTH SACRAL NERVE.

Fifth nerve ; The anterior branch of this, the lowest sacral nerve, comes forwards through the coccygeus muscle opposite the junction

nerve, the lower and much the larger of the the pudic nerve, lies below the pudic artery, expended in branches to the integument neal). It supplies offsets likewise to several nder filaments to the corpus spongiosum of these latter, before penetrating the n a considerable distance over its surface. and muscular offsets of the perinæal nerve follows :— Perinæal nerve gives filaments to corpus spongiosum. Branches of.

perinæal branches are two in number, and as posterior and anterior. The *posterior* parates from the perinæal nerve, reaches the ischio-rectal fossa, and from thence company with the anterior branch to Whilst in the fossa it gives filaments in front of the anus. It communicates nch to be next noticed, as well as with branch of the small sciatic nerve, and rrhoidal nerve. The *anterior* branch art of the ischio-rectal fossa; and, e superficial perinæal artery, ramifies part of the scrotum and on the s small twigs to the levator ani Two superficial perinæal. Posterior connections with others. Anterior. Ending.

superficial perinæal branches m pudendi.

off from the perinæal division e by a single trunk, which f the transversalis perinæi ets; these are distributed —viz. the transversalis inæ, and compressor Muscular.

r division of the the pudic artery scia, and after- he penis. It hich it passes nts for the s joined by butes offsets des of the penetrates Dorsal nerve of penis; gives branches to glans penis, to integument, and corpus cavernosum.

Is smaller in female.

In the female, this division of the pudic nerve is much smaller than in the male. It takes a similar course, and ends upon the clitoris.

Inferior hæmorrhoidal nerve.

The *inferior hæmorrhoidal* nerve arises from the pudic nerve at the back of the pelvis, or it may come directly from the sacral plexus, and be transmitted through the small sacro-sciatic foramen to the lower end of the rectum. Some of the branches of this nerve end in the external sphincter and in the adjacent skin of the anus; others reach the skin in front of that part, and communicate with the inferior pudendal branch of the small sciatic nerve, and with the superficial perinæal nerve.

SMALL SCIATIC NERVE.

Small sciatic nerve;

The small sciatic nerve (nervus ischiadicus minor) is chiefly a cutaneous nerve, supplying the integument over the posterior aspect of the thigh and (to a small extent) the leg; it furnishes also branches to one muscle — the gluteus maximus.

mode of origin;

This nerve is formed by the union of two or more nervous cords, derived from the lower part of the sacral plexus. Arising below the pyriform muscle, it descends beneath the gluteus maximus, and at the lower border of that muscle comes into contact with the fascia lata, under which it continues its course downwards along the back of the limb. The nerve perforates the fascia a little below the knee, fig. 210, [3], and, thus become subcutaneous, accompanies the short saphenous vein beyond the middle of the leg. Its terminal cutaneous branches communicate with the short saphenous nerve.

course along back of limb.

Ends below middle of leg.

Branches.

The *branches* of the small sciatic nerve are as follows:—

Inferior gluteal to gluteus maximus.

The *inferior gluteal* branches.—These are given off under the gluteus maximus, and supply the lower part of that muscle.—A distinct gluteal branch commonly proceeds from the sacral plexus to the upper part of the muscle.

Cutaneous branches.

The principal *cutaneous branches* of the nerve escape from beneath the lower border of the gluteus maximus; they form an external and an internal set.

Internal set.

The *internal* set are mostly distributed to the skin of the inner side of the thigh at the upper part. One, however, which is much larger than the rest, the *inferior pudendal* branch, turns forwards below the ischial tuberosity to reach the perinæum. Having pierced the fascia lata the cutaneous

Inferior pudendal nerve;

filaments of this branch extend forwards to the front and outer part of the scrotum, and communicate with one of the superficial perinæal nerves.

In the female, the inferior pudendal branch is distributed to the external labium pudendi. Distribution in female.

The *external* set of cutaneous branches, two or three in number, turn upwards in a retrograde course to the skin over the outer part of the great gluteal muscle. In some instances one takes a different course, descending and ramifying in the integuments on the outer side of the thigh nearly to the middle. External set.

Whilst descending beneath the fascia of the thigh, the small sciatic nerve sends off some other small cutaneous filaments. One of these, arising somewhat above the knee-joint, perforates the fascia, and is prolonged over the popliteal region to the upper part of the leg. Other cutaneous branches.

GREAT SCIATIC NERVE.

The great sciatic nerve (nervus ischiadicus), fig. 209, [7], the largest nerve in the body, distributes offsets to the back of the thigh, and supplies the leg and foot with nerves. The largest in the body;

This large nerve is the continuation of the lower end of the sacral plexus. It escapes from the pelvis through the sacro-sciatic foramen, below the pyriformis muscle, and placed deeply at the back of the limb, reaches down below the middle of the thigh, where it divides into two large branches, named the internal popliteal and external popliteal nerves. The bifurcation may take place, however, at any point intermediate between the sacral plexus and the lower part of the thigh; and, occasionally, it is found to occur even within the pelvis, a portion of the pyriformis muscle being interposed between the two great parts into which the nerve divides. is continuation of sacral plexus. Place of division.

At first the great sciatic nerve lies in the hollow between the great trochanter of the femur and the ischial tuberosity, together with the small sciatic nerve and the sciatic artery (a branch of this artery running in the substance of the nerve). It is here covered by the gluteus maximus, and rests on the external rotator muscles of the thigh. Lower down it is in contact, in front, with the adductor magnus, and is covered behind by the long head of the biceps muscle. Connections.

Is smaller in female.

In the female, this division of the pudic nerve is much smaller than in the male. It takes a similar course, and ends upon the clitoris.

Inferior hæmorrhoidal nerve.

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The small sciatic nerve (nervus ischiadicus minor) is chiefly a cutaneous nerve, supplying the integument over the posterior aspect of the thigh and (to a small extent) the leg; it furnishes also branches to one muscle — the gluteus maximus.

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course along back of limb.

beneath the gluteus maximus, and at the lower border of that muscle comes into contact with the fascia lata, under which it continues its course downwards along the back of the limb. The nerve perforates the fascia a little below the knee, fig. 210, [3], and, thus become subcutaneous, accom-

Ends below middle of leg.

panies the short saphenous vein beyond the middle of the leg. Its terminal cutaneous branches communicate with the short saphenous nerve.

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Cutaneous branches.

The principal *cutaneous branches* of the nerve escape from beneath the lower border of the gluteus maximus; they form an external and an internal set.

Internal set.

The *internal* set are mostly distributed to the skin of the inner side of the thigh at the upper part. One, however,

Inferior pudendal nerve;

which is much larger than the rest, the *inferior pudendal* branch, turns forwards below the ischial tuberosity to reach the perinæum. Having pierced the fascia lata the cutaneous

fig. 209, [8], the larger of the two divisions, following the same direction as the parent trunk, continues along the back part of the thigh and through the middle of the popliteal space. It lies at first at a considerable distance from the popliteal artery (at the outer side and nearer to the surface); but, from the knee-joint downwards, is close to the vessel, and crosses over the artery to the inner side. The nerve is covered at first by the biceps muscle, and has the same connections afterwards with neighbouring parts as the popliteal blood-vessels. the larger at first away from, afterwards close to vessels.

Branches.—The internal popliteal nerve supplies branches to the knee-joint, to the muscles of the calf of the leg, as well as to the skin on the posterior aspect of the leg, and on the dorsum of the foot at the outer margin. They are disposed as follows:— Branches.

ARTICULAR NERVES.

The articular branches are generally three in number; two of these accompany the upper and lower articular arteries of the inner side of the knee-joint, the third follows the middle or azygos artery. These nerves pierce the ligamentous tissue of the joint.—The upper one is often wanting. Three to knee-joint.

MUSCULAR BRANCHES.

The muscular branches of the internal popliteal nerve arise behind the knee-joint, while the nerve is between the heads of the gastrocnemius muscle:—

A single branch, which soon bifurcates, supplies the two parts of the *gastrocnemius*. The small nerve of the *plantaris* Branches for gastrocnemius, plantaris,

partition at the foot, is generally described in anatomical works without any separation into parts; and the name applied by different writers to this long cord, as might be expected, varies considerably, *e. g.*, "cruralis internus," or "popliteus internus," — Winslow: "tibialis posterior,"—Haller: "sciatique poplité interne,"—Sabatier: "tibieus,"—Jordens: "tibialis vel tibieus,"—Fischer, &c. One or other of the foregoing names, or some modification of them, is used by more modern writers.

As the terms "popliteal" and tibial," which are the bases of this varied nomenclature, are adapted respectively to only a particular portion of the entire nerve, it is probably best to divide the nerve into parts, and to apply to each part the appropriate designation. This arrangement has the advantage of a nearer correspondence with the manner of dividing the blood-vessels.

Fig. 209.*

Branches of trunk:

Branches of the trunk.—In its course downwards, the great sciatic nerve supplies offsets to some contiguous parts, viz. to the hip-joint, and to the muscles at the back of the thigh.

to hip-joint;

The *articular branches* are derived from the upper end of the nerve, and enter the capsular ligament of the hip-joint, on the posterior aspect. They sometimes arise from the sacral plexus.

hamstring muscles and adductor magnus.

The *muscular branches* are given off beneath the biceps muscle; they supply the flexors of the leg, viz. the biceps, semi-tendinosus, and semi-membranosus. A branch is likewise given to the adductor magnus.

Division into two parts.

Ending of the nerve.—The two large branches into which the great sciatic nerve divides are distributed to the limb from the knee downwards,

Distribution.

one (the internal popliteal) ending in the back of the leg and the sole of the foot; while the other (external popliteal) supplies the fore part of the leg and the dorsum of the foot.

INTERNAL POPLITEAL NERVE.

Internal popliteal

The internal popliteal nerve,†

* Plan of the great and small sciatic nerves. 1. Superior gluteal nerve. 2. Pudic nerve. 3. Small sciatic nerve. 5. Inferior pudendal branch. 6. Continuation of the small sciatic in the thigh. 7. Great sciatic nerve. 8. Internal popliteal nerve. 9. Posterior tibial nerve. 10, 12. Short saphenous nerve. 11. Peroneal communicating branch. 13. External popliteal or peroneal nerve.

† The inner division of the sciatic nerve, from its commencement to its

fig. 209, [8], the larger of the two divisions, following the same direction as the parent trunk, continues along the back part of the thigh and through the middle of the popliteal space. It lies at first at a considerable distance from the popliteal artery (at the outer side and nearer to the surface); but, from the knee-joint downwards, is close to the vessel, and crosses over the artery to the inner side. The nerve is covered at first by the biceps muscle, and has the same connections afterwards with neighbouring parts as the popliteal blood-vessels.

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at first away from,

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Branches.—The internal popliteal nerve supplies branches to the knee-joint, to the muscles of the calf of the leg, as well as to the skin on the posterior aspect of the leg, and on the dorsum of the foot at the outer margin. They are disposed as follows :—

Branches.

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Three to knee-joint.

MUSCULAR BRANCHES.

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A single branch, which soon bifurcates, supplies the two parts of the *gastrocnemius*. The small nerve of the *plantaris*

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As the terms "popliteal" and tibial," which are the bases of this varied nomenclature, are adapted respectively to only a particular portion of the entire nerve, it is probably best to divide the nerve into parts, and to apply to each part the appropriate designation. This arrangement has the advantage of a nearer correspondence with the manner of dividing the blood-vessels.

muscle is derived from the branch just described, or from soleus, and the main trunk (internal popliteal). The *soleus* receives a branch of considerable size, which enters the muscle on the posterior aspect after descending to it in front of the gastrocnemius. Lying deeper than the preceding branches, and arising somewhat below the joint, is the popliteus muscles. *nerve* of the *popliteus* muscle: it descends along the outer side of the popliteal vessels, and, after turning beneath the lower border of the muscle, enters the deep or anterior surface.

Fig. 210.*

EXTERNAL OR SHORT SAPHENOUS NERVE.

Short saphenous nerve; The cutaneous branch of the internal popliteal nerve (ramus communicans nervi tibiei,—Jordens ; † communicans tibialis,—auctor. var.) may be named as above, because of its following very nearly the course of the external saphenous vein. It descends along the leg beneath the fascia,

* Plan of the cutaneous nerves on the posterior aspect of the leg. 1. Inner division of the internal cutaneous nerve. 2, 2. Branches of the internal saphenous. 3. Small sciatic become cutaneous; the offset above it in a direct line is a branch of the same nerve. 4, 6. External saphenous nerve. 5. Peroneal communicating nerve.

† This nerve, and the offset of the external popliteal nerve which joins it, appear to have been first named from the fact of their connection one with another by Jordens ("Descriptio Nervi Ischiadici," Erlangæ, 1788). This manner of designating the branches in question was followed very generally by anatomical writers until late years, and it has been adopted by most neurologists,—*e. g.* Fischer ("Descript. Anatom. Nerv. lumbalium, sacralium et extremitatum inferiorum," Lipsiæ, 1791) ; Bock ("Abbildungen der Rückenmarksnerven," &c., Leipzig, 1827).

Boyer and Bichat, in their general treatises on Anatomy, have named the offset of the internal popliteal nerve "external saphenous ;" and it is not uncommon to find, in modern books, this name and the older nomenclature mixed up in the following manner :—The two branches, before their junction, are named "communicating" branches of the tibial and peroneal nerves respectively ; and the nerve resulting from their union is the external saphenous nerve. M. Cruveilhier, again, treats of the two branches as "tibial saphenous" and "peroneal saphenous."

resting on the gastrocnemius (at first between the heads of the muscle) to about midway between the knee and the foot. Here it perforates the fascia (fig. 210,[4],) and is usually joined by a branch from the external popliteal nerve (communicans peronei). After receiving this communicating branch, the external saphenous nerve descends beneath the integument near the outer side of the tendo Achillis in company with the saphenous vein, and turns forwards beneath the outer malleolus to end in the skin at the side of the foot and on the little toe. On the dorsum of the foot this nerve communicates with the musculo-cutaneous nerve.

at first is under fascia.

Joined by communicans peronei;

ends on side of foot.

In some cases, the external saphenous nerve supplies the outer side of the fourth toe, as well as the little toe. The union between the saphenous nerve and the offset of the external popliteal nerve occurs in some cases higher than usual, occasionally even at or close to the popliteal space. It sometimes happens that the communication between the nerves is altogether wanting.

Union between the branches varies;

it may be wanting.

POSTERIOR TIBIAL NERVE.

At the lower margin of the popliteus the main nerve receives this designation, and it continues through the leg with the posterior tibial artery, lying for a short space at the inner side and afterwards at the outer side of the vessel, as far as the interval between the inner malleolus and the heel; here it divides into the two plantar nerves (internal and external). The posterior tibial nerve, like the vessels, is covered at first by the muscles of the calf of the leg, afterwards only by the integument and fascia, and it rests against the deep-seated muscles.

Posterior tibial;

course;

divides into two plantar nerves.

Branches.—The deep muscles on the back of the leg and the integument of the sole of the foot receive branches from the posterior tibial nerve in its course along the leg.

Branches

The *muscular branches* emanate from the upper part of the nerve, either separately or by a common trunk; and one is distributed to each of the following muscles, viz. the tibialis posticus, the long flexor of the toes, and the long flexor of the great toe. The branch which supplies the last-named muscle runs along the peroneal artery before penetrating the muscle.

to deep muscles of leg;

The *plantar cutaneous* branch, furnished from the posterior tibial nerve, perforates the internal annular ligament, and ramifies in the integument at the inner side of the sole of the foot, and beneath the heel.

and one to skin on sole of foot.

INTERNAL PLANTAR NERVE.

Internal plantar is largest, supplies three inner toes; and fourth partly.

The internal plantar, the larger of the two nerves furnished to the sole of the foot, accompanies the internal or smaller plantar artery, and supplies nerves to both sides of the three inner toes, and to one side of the fourth. From the point at which it separates from the posterior tibial nerve, it is directed forwards under cover of the short flexor of the toes and the abductor of the great toe, and divides opposite the posterior end of the metatarsus, at the interval between the muscles just named, into four digital branches; at the same time it communicates with the external plantar nerve.

Branches to muscles and skin.

Branches.—As the internal plantar nerve courses forwards, small offsets are supplied to the abductor pollicis and flexor brevis digitorum; and some small branches perforate the plantar fascia to ramify in the integument of the sole of the foot.

Digital branches; outline of.

The *digital branches*, which are named numerically from within outwards (the innermost being first, and so on,) pass from under cover of the plantar fascia near the clefts between the toes. The first or innermost branch continues single, but the other three bifurcate to supply the adjacent sides of two toes. These branches require separate notice.

First, to inner side of great toe.

The *first* digital branch is that destined for the inner side of the great toe; it becomes subcutaneous farther back than the others, and sends off a branch to the short flexor muscle of this toe.

Second, to great toe and second.

The *second* branch having reached the interval between the first and second metatarsal bones, furnishes a small offset to the first lumbricalis muscle, and bifurcates behind the cleft between the great toe and the second to supply their contiguous sides.

Third ends on second and third toes.

The *third* digital branch, corresponding with the second interosseous space, gives a slender filament to the second lumbricalis muscle, and divides in a manner similar to that of the second branch into two offsets for the sides of the second and third toes.

Fourth, on third and fourth toes.

The *fourth* digital branch crosses to the third space, and is distributed to the adjacent sides of the third and fourth toes. It receives a communicating branch from the external plantar nerve.

Offsets to

Along the sides of the toes, cutaneous and articular fila-

MUSCULO-CUTANEOUS NERVE.

The musculo-cutaneous (peroneal) nerve is the principal cutaneous branch of the dorsum of the foot, and supplies the muscles on the outer part of the leg. It descends between the peronei muscles and the long extensor of the toes, and reaches the surface by perforating the fascia in the lower part of the leg on the anterior aspect. As soon as the nerve becomes subcutaneous, fig. 211,[3], or even before, it divides into two branches, distinguished as external and internal. When the division occurs while the nerve is in contact with the muscles, the two branches may be found to perforate the fascia at different heights.

Musculo-cutaneous nerve.

Course among muscles;

becomes subcutaneous.

Fig. 211.*

Whilst between the muscles, the musculo-cutaneous nerve gives its *muscular branches* to the peroneus longus and peroneus brevis; and, before its final division, some *cutaneous offsets* are distributed to the lower part of the leg.

Muscular branches.

Cutaneous offsets.

The *internal branch* from the division of the musculo-cutaneous nerve, fig. 211, passing forwards along the dorsum of the foot, furnishes one branch to the inner side of the great toe, and others to the contiguous sides of the second and third toes. It gives other offsets, which extend over the inner ankle and the corresponding side of the foot. This nerve communicates with the long saphenous nerve on the inner side of the foot, and with the anterior tibial nerve between the great toe and the second toe.

Inner branch gives digital nerves.

Communications.

The *external branch*, larger than the internal one, courses over the foot towards the fourth toe, which, together with the contiguous borders of the third and fifth toes, it supplies with branches. Cutaneous nerves, derived from this branch,

Outer branch supplies outer toes;

* Plan of the cutaneous nerves on the fore part of the leg, and the dorsum of the foot. 1. Internal saphenous, become subcutaneous. 2. Branches of the external popliteal. 3. Musculo-cutaneous. 4. Anterior tibial.

connections. spread over the outer ankle and the outer side of the foot, where they are connected with the short saphenous nerve.

The dorsal digital nerves are continued on to the last phalanges of the toes.

Number of digital nerves supplied by each varies.

The number of toes supplied by each of the two divisions of the musculo-cutaneous nerve is liable to vary; together, they commonly supply all the toes on their dorsal aspect, excepting the outer side of the little toe, which receives a branch from the short saphenous nerve, and the adjacent sides of the great toe and the second toe, to which the anterior tibial nerve sends a branch.

ANTERIOR TIBIAL NERVE.

Anterior tibial deeper than former; supplies chiefly muscles.

The anterior tibial (interosseous nerve), like the preceding nerve, extends through the leg to the foot, and supplies muscular and cutaneous branches; but this nerve is mostly deeply placed, and is distributed chiefly to muscles, while the largest part of the musculo-cutaneous nerve is given to the integument.

Course,

Commencing between the fibula and the peroneus longus, the anterior tibial nerve inclines obliquely beneath the long extensor of the toes to the fore part of the interosseous membrane, on which structure it comes into contact with the anterior tibial vessels, fig. 207; and with those vessels (having the same connections with neighbouring parts) it descends to the front of the ankle-joint, where it divides into an external and an internal branch. The nerve first reaches the outer side of the anterior tibial artery, above the middle of the leg; and, after crossing in front of that vessel once or oftener, lies to the outer side of it at the bend of the ankle.

to reach vessels; and with the vessels.

Offsets to muscles.

In its course along the leg, the anterior tibial nerve gives slender filaments to the muscles between which it is placed, namely, the tibialis anticus, the long extensor of the toes, and the special extensor of the great toe.

Outer branch to short extensor and tarsus.

The more *external* of the two branches which result from the division of the anterior tibial nerve, turns outwards over the tarsus beneath the short extensor of the toes; and, having become enlarged (like the posterior interosseous nerve on the wrist) terminates in branches which supply the short extensor muscle, and likewise the articulations of the foot.

Inner branch,

The *internal branch*, continuing onwards in the direction of the anterior tibial nerve, accompanies the dorsal artery of

the foot to the first interosseous space, and ends in two branches, fig. 211,[4], which supply the integument on the neighbouring sides of the great toe and the second toe on their dorsal aspect. It communicates with the internal division of the musculo-cutaneous nerve. *ends between great toe and second.*

Summary——The great sciatic nerve with its divisions supplies the integument of the leg, with the exception of the part which derives nerves from the small sciatic and the anterior crural nerve. It likewise supplies the muscles on the back of the thigh, and those of the leg and foot. The several joints of the lower limb receive filaments from the same nerve. *Summary: it supplies greater part of the limb.*

connections. spread over the outer ankle and the outer side of the foot, where they are connected with the short saphenous nerve.

The dorsal digital nerves are continued on to the last phalanges of the toes.

Number of digital nerves supplied by each varies. The number of toes supplied by each of the two divisions of the musculo-cutaneous nerve is liable to vary; together, they commonly supply all the toes on their dorsal aspect, excepting the outer side of the little toe, which receives a branch from the short saphenous nerve, and the adjacent sides of the great toe and the second toe, to which the anterior tibial nerve sends a branch.

ANTERIOR TIBIAL NERVE.

Anterior tibial deeper than former; supplies chiefly muscles. The anterior tibial (interosseous nerve), like the preceding nerve, extends through the leg to the foot, and supplies muscular and cutaneous branches; but this nerve is mostly deeply placed, and is distributed chiefly to muscles, while the largest part of the musculo-cutaneous nerve is given to the integument.

Course, Commencing between the fibula and the peroneus longus, the anterior tibial nerve inclines obliquely beneath the long extensor of the toes to the fore part of the interosseous membrane, on which structure it comes into contact with the anterior tibial vessels, fig. 207; and with those vessels (having the same connections with neighbouring parts) it descends to the front of the ankle-joint, where it divides into an external and an internal branch. The nerve first reaches the outer side of the anterior tibial artery, above the middle of the leg; and, after crossing in front of that vessel once or oftener, lies to the outer side of it at the bend of the ankle.

to reach vessels; and with the vessels.

Offsets to muscles. In its course along the leg, the anterior tibial nerve gives slender filaments to the muscles between which it is placed, namely, the tibialis anticus, the long extensor of the toes, and the special extensor of the great toe.

Outer branch to short extensor and tarsus. The more *external* of the two branches which result from the division of the anterior tibial nerve, turns outwards over the tarsus beneath the short extensor of the toes; and, having become enlarged (like the posterior interosseous nerve on the wrist) terminates in branches which supply the short extensor muscle, and likewise the articulations of the foot.

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Summary.—The great sciatic nerve with its divisions supplies the integument of the leg, with the exception of the part which derives nerves from the small sciatic and the anterior crural nerve. It likewise supplies the muscles on the back of the thigh, and those of the leg and foot. The several joints of the lower limb receive filaments from the same nerve.

Summary:

It supplies greater part of the limb.

THE SYMPATHETIC NERVE.

Sympathetic nerve; supplies viscera. Some viscera receive other nerves.

THE sympathetic system of nerves (nervus intercostalis; nerfs de la vie organique—Bichat).—The viscera generally are supplied with nerves from this system, but some organs receive likewise offsets from the cerebro-spinal system, as the lungs, the heart, and the upper and lower ends of the alimentary canal. The characters by which the sympathetic nerve is distinguished having been already pointed out, it is only necessary to say in this place that it is reddish or grey in colour, and that it is softer in texture than the cerebro-spinal nerves.

Divisions.

In this system three parts may be distinguished as follows:—

Gangliated cords; along vertebral column in whole length.

One part, which may be first noticed, communicates with the spinal nerves. It consists of two gangliated cords—or of a series of ganglia placed longitudinally and connected by intervening cords,—situate along the vertebral column, at the sides for the most part of the bodies of the vertebræ, and extending from the base of the skull to the coccyx. The two cords lie parallel to each other as far as the sacrum, on which bone they gradually converge, till they both terminate in a single ganglion on the coccyx.

Parts of cord.

This long cord is considered divisible into parts corresponding with the divisions of the vertebral column; and thus, cervical, dorsal, lumbar, and sacral portions are recognised.

Ganglia.

The ganglia are equal in number to the vertebræ on which they lie, except in the neck, where there are but three. These bodies are conveniently regarded as so many centres, giving and receiving nerves, and distributing offsets to the viscera.

Connected with spinal nerves; connecting cords contain white and grey parts.

They are severally connected with the spinal nerves in their neighbourhood by means of short cords; and each connecting cord consists of a white and a grey portion, the former proceeding from the spinal nerve to the ganglion, while the latter takes the opposite course—from the ganglion to the spinal nerve. At its upper end the gangliated cord communicates likewise with certain cranial nerves. The cords intervening between the ganglia, like those connecting the ganglia with the spinal nerves, are compounded of a

grey and a white part, the latter being continuous with the portions of spinal nerves continued to the ganglia.

Branches from ganglia on arteries to the viscera.

From the ganglia, or their intervening cords, offsets are given for the supply of the viscera; and these offsets follow the course of the arteries to the organs for which they are destined. Branches are likewise sent to join the large prevertebral plexuses to be presently noticed. The offsets from the ganglia partake of both kinds of nerves (the proper sympathetic and the spinal systems); the nerves or roots, which join the ganglia from the spinal system, being continued onwards with others which originate in the ganglia.

Nature of sympathetic.

From this circumstance, and the facts above-mentioned respecting the constitution of the gangliated cord, it follows that the so-named sympathetic nerve is composed of two forms of nerve fibre: one of which is peculiar, and originates in the ganglia of the sympathetic system, while the other is borrowed from the cerebro-spinal nerves.*

Prevertebral plexuses: receive branches from gangliated cords, and give branches to viscera.

The second division of the sympathetic comprises three large aggregations of nerves, or nerves and ganglia situate in front of the spine (prevertebral plexuses), and occupying the thorax, the abdomen, and the pelvis. They are single or unsymmetrical, and are named respectively the cardiac, the solar, and the hypogastric plexus. These plexuses receive branches from both the gangliated cords above noticed, and they constitute centres from which the viscera are supplied with nerves.

Cephalic ganglia:

In the third part will be ranged certain small ganglia which are dispersed through the cranium at irregular intervals. These are connected more or less directly with the upper part of the gangliated cords, and more immediately with the fifth pair of cranial nerves. They furnish branches for the most part to the organs of sense: and they are known as the ophthalmic, the spheno-palatine, otic, and submaxillary ganglia.

connected with fifth nerve.

The ganglia last referred to having been before fully described in connection with the fifth pair of cranial nerves, the details of the first two divisions of the sympathetic system will be here considered.

* For an account of the microscopical characters of the sympathetic nerve, see the General Anatomy of Nerve.

THE GANGLIATED CORDS.

THE CERVICAL PART.

Cervical part has but three ganglia.

In the neck each gangliated cord is deeply placed beneath the sheath of the great cervical bloodvessels, and is in contact with the muscles which immediately cover the fore part of the vertebral column. It comprises but three ganglia, which are distinguished by their relative position, being placed respectively at the upper and lower end, and the middle of the neck. The ganglia require to be separately described.

THE UPPER CERVICAL GANGLION.

First cervical is largest ganglion of cord.

This is the largest of the ganglia of the gangliated cord. It is usually fusiform in shape: but there is a good deal of variety in this respect in different cases, the ganglion being occasionally broader than usual (in various degrees), and from time to time constricted at intervals.* It has the reddish-grey colour characteristic of the ganglia of the sympathetic system; and it is placed on the larger rectus muscle, opposite the second and third cervical vertebræ, and beneath the internal carotid artery.

It is opposite 2nd and 3rd vertebræ.

Connected with four spinal nerves;

Connection with spinal nerves.—At its outer side the superior cervical ganglion is connected with the first four spinal nerves, and the connecting cords have the arrangement before pointed out in the general description (page 658).

with ninth, and with ganglia of vagus and glosso-pharyngeal nerves.

Connection with cranial nerves.—Small branches connect the ganglion or its cranial cord with the second ganglion of the pneumo-gastric, and with the ninth cranial nerve, near the base of the skull. And in this place may be likewise noticed another branch, which is directed upwards from the ganglion, and divides at the base of the skull into two filaments. One of these ends in the second (petrosal) ganglion of the glosso-pharyngeal nerve; while the other, entering the jugular foramen, joins the ganglion of the root of the pneumo-gastric.

* The occurrence of constrictions has given rise to the opinion that the ganglion may result from the coalescence of several ganglia; and in this way it has been sought to account for its greater size, and for the diminished number of the cervical ganglia.

BRANCHES OF THE GANGLION.

PHARYNGEAL NERVES AND PLEXUS.

These nerves arise from the inner part of the ganglion, and are directed obliquely inwards to the side of the pharynx. Opposite the middle constrictor muscle they unite with branches of the pneumo-gastric and glosso-pharyngeal nerves; and by their union with those nerves the *pharyngeal plexus* is constructed. Branches emanating from the plexus are distributed to the muscles and mucous membrane of the pharynx.

Pharyngeal nerves join others to form plexus.

UPPER CARDIAC NERVE.

A few preliminary remarks on the cardiac nerves are here necessary. The cervical ganglia of the sympathetic furnish each a cardiac branch, named, like the ganglion from which it arises, Upper, Middle and Lower; but as the branches are not altogether disposed in the same way on the opposite sides of the body, they will have to be noticed separately.

Cardiac nerves: one from each ganglion.

They vary on opposite sides;

The cardiac nerves are continued singly, or in connection, to the large prevertebral centre (cardiac plexus) of the thorax. In this, as in other parts of the sympathetic system, considerable variety occurs as to the disposition of the branches in different cases; and where one branch happens to be of smaller size than common, another will be found to possess an increased size, as if to compensate for the defect. But the arrangement of the branches at their termination in the organs to which they are distributed appears to be always the same.

and in different cases.

Mode of termination is constant.

The *upper cardiac nerve* (r. cardiacus superficialis) of the *right side* is constructed from two or more branches of the ganglion, with, in some instances, an offset from the cord connecting the first two ganglia. In its course in the neck the nerve lies behind the carotid sheath, in contact with the longus colli muscle; and it is placed over the lower thyroid artery and the recurrent laryngeal nerve. Entering the thorax, it passes in some cases before, in others behind the subclavian artery, and is directed along the innominate artery to the back part of the arch of the aorta, where it ends in the deep cardiac plexus, a few small filaments

First cardiac nerve;

is behind carotid sheath.

Ends in deep cardiac plexus.

continuing also to the front of the great vessel. Some branches are distributed to the thyroid body; they accompany the inferior thyroid artery.

Is connected with laryngeal nerves.

In its course downwards the cardiac nerve is repeatedly connected with other branches of the sympathetic, and with the pneumo-gastric nerve. Thus, about the middle of the neck it is joined by some filaments from the external laryngeal nerve; and, rather lower down, by one or more filaments from the trunk of the pneumo-gastric nerve; lastly, on entering the chest, it joins with the recurrent laryngeal. —Instead of passing to the thorax in the manner above described, the nerve may be found to join the cardiac branch furnished from one of the other cervical ganglia.*

On left side,

The superficial cardiac nerve of the *left side* has, while in the neck, the same course and connections as that of the right side. But within the chest it follows the left carotid artery to the arch of the aorta, and ends in some instances in the superficial cardiac plexus, while in others it joins the deep plexus; and accordingly it passes either in front of the arch of the aorta or behind it.

ends in the superficial cardiac plexus.

BRANCHES TO BLOOD-VESSELS.

Nervi molles accompany branches of carotid;

The nerves which ramify on the arteries (nervi molles) spring from the front of the ganglion, and reach the trunk of the carotid artery, around which they entwine. An offset is continued on each branch of the external carotid, and forms a slender plexus upon it. These nerves or plexuses have the same designation as the arteries they surround. From the plexus on the facial artery is derived the filament which joins the submaxillary ganglion; and, from that on the middle meningeal artery, offsets have been described as extending to the otic ganglion, as well as to the gangliform enlargement of the facial nerve (page 561, fig. 194). Lastly, a communication is established between the plexus on the carotid artery and the digastric branch of the facial nerve.

join submaxillary and otic ganglia,

and facial nerve.

Ganglia on nervi molles.

Small ganglia are occasionally found on some of the foregoing vascular plexuses, close to the origin of the vessels with which they are associated. Those which have been

* Scarpa describes this as the common disposition of the superficial cardiac nerve, but M. Cruveilhier (Anat. Descript., t. iv.) states that he has not in any case found the cardiac nerves to correspond exactly with the figures of the "Tabulæ Neurologicæ."

described are an intercarotid one (placed in the angle of the bifurcation of the common carotid artery), and lingual, temporal, and pharyngeal ganglia.

The foregoing branches will be found to correspond in a great measure with the branches of other ganglia; but we now proceed to examine an offset which is peculiar to the first cervical ganglion. Like other offsets.

ASCENDING OR CRANIAL BRANCH.

The ascending offset of the first cervical ganglion is soft in texture and of a reddish tint, seeming to be in some degree a prolongation of the ganglion itself. In its course to the skull, it is concealed by the internal carotid artery, with which it enters the carotid canal in the temporal bone; and it is then divided into two parts, which are placed one on the outer, the other on the inner side of the vessel. Cranial, prolongation on carotid from first ganglion. Its two parts.

The *external part*, or division, distributes filaments to the internal carotid artery, and, after communicating by means of other filaments with the internal division of the cord, forms the *carotid plexus*. External part forms carotid plexus.

The *inner division*, rather the smaller of the two, supplies filaments to the carotid artery, and goes to form what is named the *cavernous plexus*. The terminal parts of these divisions of the cranial cord are prolonged on the trunk of the internal carotid, and extend to the cerebral and ophthalmic arteries, around which they form secondary plexuses, and those on the former vessel ascend to the pia mater enveloping the brain.* One plexus enters the eye-ball with the central artery of the retina. Internal part forms cavernous plexus: plexuses on cerebral and ophthalmic arteries.

CAROTID PLEXUS.

The carotid plexus, situate, as before mentioned, on the outer side of the internal carotid artery at its second bend (reckoning from below), or between the second and third Carotid plexus; its position.

* It was said by Ribes (Mem. de la Société Méd. d'Emulation, tom. viii. p. 606,) that the cranial prolongations of the sympathetic nerve from both sides were joined one with another on the anterior communicating artery,—a small ganglion or a plexus being formed at the point of juncture. This connection has not been satisfactorily made out by other observers.

bends, joins the fifth and sixth cranial nerves, and gives many filaments to the vessel on which it lies.*

Branches join sixth nerve ;

Branches.—The connection with the *sixth nerve* is established by means of one or two filaments of considerable size, which are supplied to that nerve where it lies by the side of the internal carotid artery.

and fifth.

The filaments connected with the *Gasserian ganglion* of the fifth nerve proceed in one case from the carotid plexus, in another from the cavernous.

A branch forms deep part of Vidian.

The filament which constitutes the deep branch or part of *the Vidian nerve* is directed forwards to the pterygoid canal, through the cartilaginous substance closing the foramen lacerum in the base of the skull. In that canal it becomes associated with the deep branch of the Vidian, and is continued forward to the spheno-palatine ganglion. (See page 554.)

CAVERNOUS PLEXUS.

Cavernous plexus.

Position.

The cavernous plexus, named from its position in the sinus of the same name, is placed below and rather to the inner side of the highest turn of the internal carotid artery. Besides giving branches on the artery, it communicates with the third, the fourth, and fifth cranial nerves, which enter the orbit.†

Branches join the third, fourth, and

Branches.—The filament which joins the *third nerve* comes into connection with it close to the point of division of that nerve.

The branch to the *fourth nerve*, which may be derived from either the cavernous or carotid plexus, joins the nerve where it lies in the wall of the cavernous sinus.

fifth cerebral nerves.

The filaments connected with the *ophthalmic trunk* of the *fifth* nerve are supplied to its inner surface. One of them is continued forwards to the lenticular ganglion, either in connection with or distinct from the nasal nerve (p. 546).

MIDDLE CERVICAL GANGLION.

Second cer-

The middle ganglion (ganglion thyroideum), which is

* Valentin describes nerves as furnished to the dura mater from this plexus.

† A second communication between the sympathetic and the sixth nerve, taking place below the bend of the carotid, has been described by some anatomists.

much the smallest of the cervical ganglia, is placed on or near the inferior thyroid artery. It is usually connected in the ordinary way with the fifth and the sixth spinal nerves, but the communication with those nerves is not constant. vical ganglion very small; joins spinal nerves.

BRANCHES OF THE GANGLION.

THYROID BRANCHES.

From the inner side of the ganglion some nerves proceed along the inferior thyroid artery to the thyroid body, where they join the recurrent laryngeal and the external laryngeal nerves. Whilst on the artery these branches communicate with the upper cardiac nerve. Branches for thyroid body.

MIDDLE CARDIAC NERVE.

The middle cardiac nerve (nervus cardiacus profundus v. magnus) is prolonged to the chest beneath the sheath of the common carotid artery, and in front of or behind the subclavian artery. In the chest it lies on the trachea, where it is joined by filaments of the recurrent laryngeal nerve, and it ends in the right side of the deep cardiac plexus. While in the neck, the nerve communicates with the upper cardiac nerve and the recurrent branch of the pneumo-gastric.—When the middle cervical ganglion is small, the middle cardiac nerve may be found to be an offset of the interganglionic cord. Middle cardiac nerve in the neck; in the chest; ends in deep cardiac plexus. Communication with others.

The foregoing account of the nerve has reference to the right side of the body: on the *left side*, the middle cardiac nerve enters the chest between the left carotid and subclavian arteries, and joins the left side of the deep cardiac plexus. Left nerve.

LOWER CERVICAL GANGLION.

The lower or third cervical ganglion is irregular in shape, usually somewhat round or semilunar, and is frequently united in part to the first thoracic ganglion. Placed in a hollow between the transverse process of the last cervical vertebra and the neck of the first rib, it is concealed by the vertebral artery. Third cervical ganglion rests on first rib:

Connection with spinal nerves.—This ganglion is connected directly by short communicating cords, in the joins last two spinal nerves, and

indirectly others.

manner of other ganglia, with the last two cervical nerves. Moreover, branches which pass from the ganglion along the vertebral artery (see page 267), supplying twigs to this vessel, are also connected with other cervical nerves, and thus additional communications are established between the two systems.

BRANCHES OF THE GANGLION.

LOWER CARDIAC NERVE.

Third cardiac nerve: ends in deep cardiac plexus. Communications.

The lower cardiac nerve, issuing from the third cervical ganglion or from the first thoracic, and inclining inwards behind the subclavian artery, terminates, like the other cardiac nerves, in the cardiac plexus behind the arch of the aorta. It communicates with the middle cardiac and recurrent laryngeal nerves behind the subclavian artery.

Nerve of left side.

On the *left side*, the lower cardiac often becomes blended with the middle cardiac nerve, and the cord resulting from their union terminates in the deep cardiac plexus.

BRANCHES TO BLOOD-VESSELS.

Plexus on vertebral artery: connected with spinal nerves.

From the lowest cervical and first dorsal ganglia a few slender branches ascend along the vertebral artery in its osseous canal, forming a plexus round the vessel by their intercommunications, and supplying it with offsets.* This plexus is connected with the cervical spinal nerves as far upwards as the fourth.

Loops on subclavian artery.

A couple of branches pass from the lower cervical ganglion to the first dorsal ganglion in front of the subclavian artery, forming loops round the vessel (ansæ Vieussenii), and supplying it with small offsets.

THORACIC PART OF THE GANGLIATED CORD.

Gangliated cord in chest behind pleura.

In the thorax the knotted cord is placed on the side of the spinal column, over the line of the heads of the ribs; and it is uninterruptedly continuous with the corresponding

* Little gangliform enlargements have been described as existing on the plexus, but they do not possess the cells which belong to true ganglia (Valentin). The existence of the enlargements in question is doubted by M. Cruveilhier.

part in the neck and the abdomen. It is covered by the pleura.

Opposite the head of each rib the cord presents for the most part a greyish enlargement or ganglion, so that there are commonly twelve of these; but, from the occasional coalescence of two masses, the number is uncertain. The first ganglion is much larger than the rest, and is of an elongated form. It is often blended with the lower cervical ganglion. The rest are small, and are not inaptly described as hordeïform. Twelve ganglia: first the largest.

Fig. 212.*

Connection with the spinal nerves. — The branches of connection between the spinal nerves and the ganglia of the sympathetic, fig. 212, are usually two in number for each ganglion. Each has two connecting cords with spinal nerves.

BRANCHES OF THE GANGLIA.

The branches furnished by the *first six ganglia*, fig. 212, are much smaller than those of the lower six, and are distributed in a great measure to the thoracic aorta, the vertebræ, and ligaments. One or two branches enter the posterior pulmonary plexus.† Branches of first six, small, end on aorta and bones.

The branches furnished by the *lower six ganglia* unite into Branches o

* A representation of the ganglia of the sympathetic in the chest; (the ganglia are represented larger than natural.) The wood-cut is taken from part of a plate in Mr. Swan's work.—*a*. Aorta. *b*. First rib. *c*. Eleventh rib. 1. First thoracic ganglion. 2. Last thoracic ganglion. 3. Large splanchnic nerve. 4. Small splanchnic nerve. 5. Smallest splanchnic nerve. 6. Part of the brachial plexus.

† Mr. Swan represents branches of the second, third, and fourth ganglia as united in a *plexus* (which he names thoracic) on the bodies of the vertebræ. Offsets from the plexus are mentioned by this anatomist as entering the pulmonary and cardiac plexuses, while some are continued beneath the œsophagus to the corresponding plexus on the opposite side.

lower six, give three splanchnic nerves to abdomen.

cords, which pass from the thorax to the abdomen, and join plexuses in the latter cavity. The cords referred to are three in number on each side, are named "splanchnic," and are distinguished as the great, the small, and the smallest splanchnic nerve.* They are placed in the thorax in the order in which they are here mentioned, the largest being at the same time highest, and the smallest lower than the rest.

THE GREAT SPLANCHNIC NERVE.

Great splanchnic nerve formed from several thoracic ganglia.

This nerve or cord, fig. 212,[3], appears at first sight to be formed by roots supplied by the thoracic ganglia from the sixth or seventh to the tenth inclusive ; but, by examination after immersion in acetic or diluted nitric acid, small filaments may be traced upwards as far as the third ganglion, or even, according to Mr. Beck, as far as the first.†

Course; perforates diaphragm; ends in semilunar ganglion.

Gradually augmented by the successive addition of the several roots, the cord descends obliquely inwards over the bodies of the dorsal vertebræ ; and, after perforating the crus of the diaphragm, (the point at which it passes through the muscle varying in different cases,) terminates in the semilunar ganglion, frequently sending some filaments to the renal plexus and the suprarenal body.

The splanchnic nerve is remarkable from its white colour and firmness, which are owing to the preponderance of the spinal nerve-fibres in its composition.

May be plexiform and gangli-onic.

In the chest the great splanchnic nerve is not unfrequently divided into parts, and forms a little plexus with the small splanchnic nerve. Occasionally too a small ganglion (ganglion splanchnicum) is formed on it over the last dorsal vertebra, or the last but one ; and when it presents a plexiform arrangement, several small ganglia have been observed on its divisions.

SMALL SPLANCHNIC NERVE.

Second

The small or second splanchnic nerve, fig. 212,[4], springs

* Wrisberg noticed a fourth splanchnic nerve, which he found but eight times, though he sought it in many bodies. He proposed to call it the highest splanchnic nerve (nervus splanchnicus supremus). It is described as formed by offsets from the cardiac nerves, and from the lower cervical, as well as some of the upper thoracic ganglia. Consult the "Observ. Anatom. de Nerv. Viscerum particula prima," p. 25, sect. iij. "De nervo sympathico maximo."

† See a paper entitled "On the Nerves of the Uterus, by J. S. Beck, Esq." in the Philosophical Transactions, Part 2, for 1846.

from the tenth and eleventh ganglia, and from the cord between those ganglia. It continues with the preceding nerve through the diaphragm, and ends in the cœliac plexus. In the chest this nerve communicates often with the large splanchnic nerve; and in some instances it furnishes filaments to the renal plexus, especially if the lowest splanchnic nerve is very small or wanting.

splanchnic nerve; ends in cœliac plexus.

SMALLEST SPLANCHNIC NERVE.

This nerve (nerv. renalis posterior—Walter), fig. 212,[5], arises from the last thoracic ganglion, and communicates sometimes with the nerve last described. After piercing the diaphragm, it ends in the renal plexus, and in the lowest part of the cœliac plexus.

Third splanchnic nerve; ends in renal plexus.

LUMBAR PART OF THE GANGLIATED CORD.

In the lumbar region the two gangliated cords, continuing from the thoracic series of ganglia behind the diaphragm, approach one another more nearly than in the thorax. They are placed before the bodies of the vertebræ, each lying along the inner margin of the psoas muscle; and that of the right side is partly covered by the vena cava.

Gangliated cords on vertebræ closer to each other.

The ganglia are small, and hordeïform in shape. They are commonly four in number, but occasionally their number is diminished, and then their size is proportionally enlarged.

Four ganglia.

Connection with spinal nerves.—In consequence of the greater distance at which the lumbar ganglia are separated from the intervertebral foramina of the spine, the branches connecting them with the spinal lumbar nerves are longer than in other parts of the gangliated cord. There are generally two connecting branches for each ganglion, but the number is not so uniform as it is in the chest; nor are those belonging to any one ganglion connected always with the same spinal nerve.

Branches joining spinal nerves are long.

The connecting branches accompany the lumbar arteries, and, as they cross the bodies of the vertebræ, are covered by the fibrous bands from which the larger psoas muscle partly takes its origin.

BRANCHES OF THE LUMBAR GANGLIA.

The branches of these ganglia are uncertain in their

Branches go

to aortic and hypogastric plexuses.

number. Some join a plexus on the aorta; others descending go to form the hypogastric plexus. Several filaments are distributed to the vertebræ, and to the ligaments connecting those bones.

SACRAL PART OF THE GLANGLIATED CORD.

Gangliated cords on sacrum converge and are connected on coccyx.

Over the sacrum the gangliated cord of the sympathetic nerve is much diminished in size, and gives but few branches to the viscera. Its position on the front of the sacrum is along the inner side of the anterior sacral foramina; and, like the two series of those foramina, the two cords approach one another in their progress downwards. The upper end of each is connected with the last lumbar ganglion by a single or a double interganglionic cord; and at the opposite end, they are connected by means of a loop with a single median ganglion on it. This ganglion, *ganglion impar*, is placed on the fore part of the coccyx. The sacral ganglia are usually five in number; but the want of constancy both in size and number is more marked in these than in the thoracic or lumbar ganglia.

Ganglion impar.

Five sacral ganglia.

Branches joining spinal nerves very short.

Connection with spinal nerves.—From the proximity of the sacral ganglia to the spinal nerves at their emergence from the bone, the communicating branches are very short: they are two in number for each ganglion, and are in some cases connected with two different sacral nerves. The coccygeal nerve communicates with the last sacral, or the coccygeal ganglion.

BRANCHES OF THE SACRAL GANGLIA.

Branches are small.

The branches are much smaller in size than those from the ganglia in other parts of the cord. They are for the most part expended on the front of the sacrum, and join the corresponding branches from the opposite side. Some filaments from one or two of the first ganglia enter the hypogastric plexus, while others go to form a plexus on the middle sacral artery. From the lower end of the sympathetic (*i.e.* the loop connecting the two cords, and on which the coccygeal ganglion is formed), filaments are given to the coccyx and the ligaments about it.

Twigs to hypogastric plexus, and on middle sacral artery.

PREVERTEBRAL PART OF THE SYMPATHETIC.

This portion of the sympathetic system, it has been already stated, consists of certain unsymmetrical plexuses placed before the spine, and serving as centres from which nerves are furnished to the viscera. Those recognised are the cardiac, solar, and hypogastric plexuses. They are composed of assemblages of nerves, or nerves and ganglia. Each receives nerves from the gangliated cord of both sides; and these nerves, as will presently appear in the special description of the plexuses, take origin from the ganglia at a distance above the plexus.

Prevertebral plexuses in chest, abdomen and pelvis.

Each receives nerves from gangliated cords,

From the plexuses are furnished branches or secondary plexuses for the supply of the viscera. These offsets accompany the arteries in their course to the viscera for which they are respectively destined.

and gives branches to viscera.

CARDIAC PLEXUS.

The prevertebral plexus of the thorax is thus named. To it several branches (cardiac), given from the cervical ganglia of the sympathetic, and from the vagus nerve, converge as to a common centre; and from it proceed the nerves which supply the heart, as well as some offsets which assist in supplying the lungs.

Cardiac plexus; outline of.

The large cardiac plexus of nerves lies above the base of the heart, upon the two great arteries which issue from it (aorta, and pulmonary artery). In the general network formed by these nerves two subdivisions are reckoned, which are partly separated from each other, and are distinguished as the superficial, and the deep or great cardiac plexus. The branches pass from these to the heart in two bundles, which accompany the nutritious arteries of that organ, and from this circumstance are called coronary plexuses.

Situation.

Divided into two parts or plexuses.

Branches to heart.

SUPERFICIAL CARDIAC PLEXUS.

The superficial cardiac plexus lies in the concavity of the arch of the aorta, in front of the right branch of the pulmonary artery. In it the superficial or first cardiac nerve of the left side terminates, either wholly or in part, together with the lower cardiac branch of the left pneumo-gastric nerve (in some cases, also, that of the right side); and it is

Superficial plexus in curve of aorta.

Nerves joining in it.

joined by a prolongation forwards from the deep cardiac plexus. A small ganglion (*ganglion of Wrisberg*) is frequently found at the point of union of the nerves. It ends in the anterior coronary plexus; and it furnishes laterally filaments along the pulmonary artery to the anterior pulmonary plexus of the left side.

Ganglion of Wrisberg.

The *anterior coronary plexus*, a prolongation in greatest part from the superficial cardiac plexus above described, is at first continued forwards between the aorta and the pulmonary artery, and is thence conducted by the right or anterior coronary artery to the heart. Where the anterior coronary artery appears between the large vessels, the coronary plexus receives an accession from the deep cardiac plexus.

Anterior coronary plexus; how formed.

DEEP CARDIAC PLEXUS.

Deep cardiac plexus, is behind arch of aorta.

The deep cardiac plexus (plexus magnus profundus—Scarpa) is much larger than the superficial one, and is placed behind the arch of the aorta, between it and the end of the trachea, and above the point of division of the pulmonary artery.

Nerves ending in it.

This plexus receives all the cardiac branches of the cervical ganglia of the sympathetic nerve, except the first one (superficial cardiac nerve) of the left side. It likewise receives the cardiac nerves furnished by the vagus and by the recurrent laryngeal branch of that nerve, with the exception of the lower cardiac nerve of the left side.

Branches end mostly in posterior coronary plexus.

The nerves issuing from the deep cardiac plexus end in greatest part in the posterior coronary plexus; but some join the anterior coronary plexus, and a few filaments are added to the pulmonary plexuses.

Course of coronary nerves from right

There is some difference as to the course pursued by the nerves issuing from the plexus on the right and left side. The branches descending from the *right side* of the plexus pass, some in front of the right pulmonary artery, others behind the vessel: the former, which is much the more numerous set, after sending some filaments to the anterior pulmonary plexus, are directed along the trunk of the pulmonary artery, and become part of the anterior coronary plexus; while the nerves behind the right pulmonary artery are distributed to the right auricle of the heart, and a few filaments are continued into the posterior coronary plexus.

and left part.

On the *left side*, a few branches pass forwards by the

ductus arteriosus to join the superficial cardiac plexus; but the great body of the nerves of this side end in the posterior coronary plexus, after giving branches to the left auricle of the heart, and to the anterior pulmonary plexus.

The *posterior coronary plexus* is derived chiefly from the left part of the deep cardiac plexus, but is joined by nerves from the right portion of that plexus. It surrounds the branches of the coronary artery at the back of the heart, and supplies mostly the muscular substance of the ventricles. The nerves constituting the coronary plexuses accompany, as already stated, the branches of the arteries, and, after subdividing minutely, enter the muscular substance of the heart.

Posterior coronary plexus from deep cardiac plexus, follows arteries: nerves supply muscular structure;

Nervous filaments are said to ramify under the lining membrane of the heart, but they are not as easily distinguished in man as in some animals, the sheep, for example. (Valentin.) Ganglia of small size have been found by Remak * on the branches of the cardiac nerves in several mammifers, both on the surface of the heart and in the muscular substance, where they were observed to be very numerous; but Valentin failed to detect such ganglia in the human heart.

some under endocardium.

EPIGASTRIC OR SOLAR PLEXUS.

The epigastric plexus, which is the largest of the prevertebral centres, is placed at the upper part of the abdomen, behind the stomach, and in front of the aorta and the pillars of the diaphragm. Surrounding the origin of the cœliac axis and the upper mesenteric artery, it occupies the interval between the suprarenal bodies, and extends downwards as far as the pancreas. The plexus consists of nervous cords, with several ganglia of various size connected with them. The large splanchnic nerves of both sides, and some branches of the pneumo-gastric, terminate in it. The offsets or branches sent from it are very numerous, and accompany the arteries to the principal viscera of the abdomen, constituting so many secondary plexuses on the vessels.

Solar plexus, close to cœliac and mesenteric arteries; receives splanchnic nerves and branches of vagus.

Ganglia.—The solar plexus contains, as already mentioned, several ganglia; and by the presence of these bodies, and their size, it is distinguished from the other prevertebral plexuses. Two of the ganglia (one for each side), which differ from the rest by their greater size, require separate notice. Named *semilunar*, though they have often little of the form the name implies, they occupy the upper and outer

Ganglia. Semilunar is the principal one;

* Müller's Archiv. 1844.

part of the plexus on each side, and are placed close to the suprarenal bodies by the side of the cœliac and the superior mesenteric arteries. At the upper end, which is expanded, each ganglion receives the great splanchnic nerve; and from it, branches radiate in different directions.

receives great splanchnic nerve.

OFFSETS FROM THE PLEXUS.

Branches of solar plexus accompany the branches of aorta.

The offsets have the same plexiform arrangement as the large plexus from which they are derived. Each secondary plexus, as it accompanies a branch of the aorta, surrounds the vessel with a kind of membranous sheath, and is named from the vessel by which it is supported. Accordingly, diaphragmatic, cœliac, renal, mesenteric, and other plexuses are recognised.

DIAPHRAGMATIC PLEXUS.

Diaphragmatic nerves

sink into diaphragm.

The nerves (inferior diaphragmatic) composing this plexus are derived from the upper part of the semilunar ganglion, and are larger on the right than on the left side. Accompanying the arteries along the lower surface of the diaphragm, the nerves sink into the substance of the muscle. They furnish some filaments to the suprarenal body, and join with the spinal phrenic nerves.

Ganglion on right side where join phrenic nerve.

Twigs to hepatic plexus on left side.

At the right side, on the under surface of the diaphragm, and near the suprarenal body, there is a small ganglion—*ganglion diaphragmaticum*, which marks the junction between the phrenic nerves of the spinal and sympathetic systems. From this small ganglion filaments are distributed to the vena cava, the suprarenal body, and the hepatic plexus. On the left side the ganglion is wanting, but some filaments are prolonged to the hepatic plexus.

SUPRARENAL PLEXUS.

Suprarenal plexus;

joined by a splanchnic

The suprarenal nerves issue from the solar plexus, and the outer part of the semilunar ganglion, a few filaments being added from the diaphragmatic nerve. They are short, but numerous in comparison with the size of the body which they supply; and they enter the upper and inner parts of the suprarenal capsule. These nerves are continuous below with the renal plexus. The plexus is joined by branches from one of the splanchnic nerves, and presents a ganglion

(*gangl. splanchnico-supra-renale*), where it is connected with those branches. The plexus and ganglion are smaller on the left than on the right side. nerve with ganglion.

RENAL PLEXUS.

The nerves forming the renal plexus, which are about fifteen or twenty in number, emanate for the most part, like the preceding nerves, from the outer part of the semilunar ganglion; but some are added from the solar plexus and the aortic plexus. Moreover, filaments of the smallest splanchnic nerve, and occasionally from the other splanchnic nerves, terminate in the renal plexus. As they follow onwards the renal artery, ganglia of different sizes are formed on these nerves. Lastly, dividing with the branching of the vessel, the nerves follow the vessels into the substance of the kidney. On the right side some filaments are furnished to the vena cava, behind which the plexus passes with the renal artery; and others go to form the spermatic plexus.

Renal plexus; joined by third splanchnic nerve. Twigs for vena cava.

SPERMATIC PLEXUS.

This small plexus commences in the renal plexus, but receives in its progress with the spermatic artery an accession from the aortic plexus. Continuing downwards to the testis, the spermatic nerves are connected with others which accompany the vas deferens and its artery from the pelvis.

Spermatic plexus, joined by nerves on vas deferens.

In the female, the plexus, like the artery, is distributed to the ovary and the uterus.

CŒLIAC PLEXUS.

The cœliac plexus is of large size, and is derived from the fore part of the great epigastric plexus. It surrounds the cœliac axis in a kind of membranous sheath, and subdivides, as the artery, into coronary, hepatic, and splenic plexuses. The plexus receives offsets from one or more of the splanchnic nerves, and on the left side a branch from the pneumo-gastric nerve is continued into it (Swan).

Cœliac divides into three plexuses.

The *coronary plexus* is placed with its artery along the small curvature of the stomach, and unites with the nerves which accompany the pyloric artery, as well as with branches of the pneumo-gastric nerves. The nerves of this plexus enter the coats of the stomach, after lying a short distance beneath the peritoneum.

Coronary of stomach, joins pyloric and vagus nerves.

Hepatic

is joined by twigs of left vagus;

gives secondary plexuses, viz. pyloric to stomach;

gastro-epiploic and gastro-duodenal to stomach, duodenum, and pancreas;

and cystic for gall-bladder.

The *hepatic plexus*, the largest of the three divisions of the cœliac plexus, ascends with the hepatic vessels and the bileduct, and, entering the substance of the liver, ramifies on the branches of the vena portæ and the hepatic artery. Offsets from the left pneumo-gastric and diaphragmatic nerves join the hepatic plexus at the left side of the hepatic vessels. From this plexus filaments are furnished to the right suprarenal plexus, as well as other secondary plexuses which follow the branches of the hepatic artery. Thus there is with the pyloric artery a *pyloric plexus*, which gives branches on the small curvature of the stomach, and is connected with the pneumo-gastric nerves, as well as with the plexus on the coronary artery. Again, a *gastro-epiploic* and a *gastro-duodenal plexus* are furnished from the hepatic plexus. The former surrounds the right gastro-epiploic artery, and communicates with the nerves from the splenic plexus, which lie on the left gastro-epiploic vessel; while the gastro-duodenal plexus supplies the duodenum and the pancreas, and joins the mesenteric plexus. The plexuses just noticed supply filaments to the stomach, chiefly at its pyloric end. Near the liver the *cystic plexus* is derived from the same source as the nerves last described, and is conveyed to the gall-bladder by the cystic artery.

Splenic plexus, besides spleen,

furnishes stomach and pancreas with nerves.

The *splenic plexus* is continued on the splenic artery and its divisions into the substance of the spleen. This plexus is reinforced at its beginning by branches from the left semilunar ganglion, and by a filament from the right vagus nerve. It furnishes the *left gastro-epiploic* and *pancreatic* plexuses, which course along the branches of the splenic artery bearing the same appellation, and, like the vessels, are distributed to the stomach and pancreas.

SUPERIOR MESENTERIC PLEXUS.

Superior mesenteric plexus.

Ganglia.

The plexus accompanying the superior mesenteric artery, whiter in colour and firmer than either of the preceding offsets of the solar plexus, envelops the artery in a membraniform case, and receives a prolongation from the junction of the right pneumo-gastric nerve with the cœliac plexus. About the root of the artery, ganglionic masses (gangl. meseraica) occur in connection with the nerves of this plexus.

Nerves to same parts

The offsets of the plexus are in name and number the

same as the vessels; and, in the same manner as the vessels, they supply the greater part of the small intestines, viz. the jejunum and ileum, as well as the ascending and the transverse colon. The pancreas also receives nerves from the superior mesenteric plexus. The nerves are distributed as follows:— *of intestines as the arteries they accompany.*

Closely encircling the superior mesenteric artery, the plexus enters with that vessel between the layers of the mesentery, and furnishes secondary plexuses around the branches of the artery; viz. *intestinal* nerves to the small intestine, and plexuses for the supply of the large intestine, named severally *ileo-colic*, *right colic*, and *middle colic*. In their progress to the intestine some nerves quit the arteries which first supported them, and are directed forwards in the intervals between the vessels. As they proceed, they divide, and unite with lateral branches, like the arteries, but without the same regularity; and they enter the intestine where the mesentery is connected with it. The highest of the foregoing nerves, those on the jejunum, communicate with the gastro-duodenal plexus; and those distributed to the transverse colon (middle colic nerves) join with the left colic nerves furnished from the inferior mesenteric plexus. *Offsets; intestinal and colic; distribution. Connections between the nerves.*

THE AORTIC PLEXUS.

The aortic or intermesenteric plexus is placed along the abdominal aorta, and occupies the interval between the origin of the superior and inferior mesenteric arteries. This plexus may be considered a prolongation of the solar plexus, which supplies nerves to accompany some of the lower branches of the aorta. Above, it consists, for the most part, of two lateral portions, connected with the semilunar ganglia and renal plexuses, which are extended on the sides of the aorta, and have communicating branches over that vessel. It is joined, moreover, by branches of some of the lumbar ganglia. *Aortic plexus; placed at sides and in front of aorta;*

The aortic plexus furnishes the inferior mesenteric plexus and part of the spermatic, gives some filaments to the lower vena cava, and ends in the hypogastric plexus. *Offsets; and supplies vena cava.*

INFERIOR MESENTERIC PLEXUS.

The inferior mesenteric plexus is derived principally *Inferior*

mesenteric plexus

from the left lateral part of the aortic plexus, and closely surrounds with a network the inferior mesenteric artery.

supplies same parts as artery of same name.

It distributes nerves to the left or descending part and the sigmoid flexure of the colon, and assists in supplying the rectum. The nerves of this plexus, like those of the superior mesenteric plexus, are firm in texture, and whitish in colour.

Offsets; colic, sigmoid, and hæmorrhoidal.

As it proceeds along the artery, the inferior mesenteric plexus divides into the following secondary plexuses, viz. *left colic*, *sigmoid*, and *superior hæmorrhoidal*, which surround respectively the branches of the artery. In their progress to the intestine, the nerves of these plexuses subdivide, and join, like the branches of the superior mesenteric nerves: the highest branches (those on the left colic artery) are connected with the last branches (middle

Junctions.

colic) of the superior mesenteric plexus, while others in the pelvis unite with offsets derived from the pelvic plexus of the left side.

HYPOGASTRIC PLEXUS.

Hypogastric plexus,

The hypogastric plexus (plexus hypogastricus superior, seu uterinus communis — Tiedemann; plex. hypogastr. medius seu impar—Müller; inferior aortic plexus), the

placed between common iliac arteries.

prevertebral assemblage of nerves destined for the supply of the viscera of the pelvis, lies invested in dense fibrous tissue, in the interval between the two common iliac arteries. The nerves from which it is formed, about twelve

Nerves entering it.

in number on each side, descend from the aortic plexus, receiving filaments from the lumbar ganglia; and, after crossing the common iliac artery, form an interlacement with as many nerves from the opposite side. The plexus

No ganglia in this plexus.

contains no ganglia. At the lower end it divides into two parts, which are directed forwards, one to each side of the pelvic viscera.

PELVIC PLEXUS.

Pelvic plexus;

The pelvic or inferior hypogastric plexus (plexus gangliosus inferior; hypogastricus lateralis inferior—Tiedemann; plexus hypogastricus inferior—Müller; pelvic plexus—Beck) is placed in the lower part of the pelvic cavity by the side of the rectum, or the vagina in the female. From the hypogastric plexus a prolongation is continued downwards

on each side to the lower part of the rectum, its branches entering into repeated communications as they descend, and forming at the points of connection small knots, which contain a little ganglionic matter. After descending some way, they become united with branches of the spinal nerves, as well as with a few offsets of the sacral ganglia, and the union of all constitutes the pelvic plexus. The spinal branches, which enter into the plexus, are furnished from the third and fourth sacral nerves (in greatest number by the former of these); a couple of filaments being likewise added from the second sacral nerve. Small ganglia are formed at the place of union of the spinal nerves, as well as elsewhere in the plexus (plexus gangliosus—Tiedemann).

one at each side of pelvic viscera.

Formed by branches of hypogastric plexus, and of sacral nerves.

Ganglia.

OFFSETS OF THE PLEXUS.

From the plexus so constituted numerous nerves are distributed to the pelvic viscera. They correspond with the branches of the internal iliac artery, and of course vary with the sex; thus, besides hæmorrhoidal and vesical nerves, which are common to both sexes, there are nerves special to each:—namely, in the male, for the prostate, vesicula seminalis, and vas deferens; in the female, for the vagina, uterus, ovary, and Fallopian tube.

Branches of plexus follow arteries to all the pelvic viscera.

The nerves distributed to the urinary bladder and the vagina contain a larger proportion of spinal nerves than those furnished to the other pelvic viscera.—The offsets of the pelvic plexus will be now noticed separately.

Vesical and vaginal nerves differ from rest.

INFERIOR HÆMORRHOIDAL NERVES.

These slender nerves pass away from the back part of the pelvic plexus. They join with the nerves (superior hæmorrhoidal) which descend with the inferior mesenteric artery, and penetrate the coats of the rectum.

Inferior hæmorrhoidal joined to superior.

VESICAL PLEXUS.

The nerves of the urinary bladder are very numerous. They are directed from the anterior part of the pelvic plexus to the side and lower part of the bladder. At first, these nerves accompany the vesical blood-vessels, but afterwards they leave the vessels, and subdivide into minute branches before perforating the muscular coat of the organ. From

Vesical nerves numerous.

Special offsets to vas deferens and vesicula seminalis.

the vesical plexus, nerves, or what may be considered secondary plexuses, are given in the male to the vas deferens and the vesicula seminalis.

The *nerves of the vas deferens* ramify around that tube, and communicate in the spermatic cord with the nerves of the spermatic plexus. Those furnished to the *vesicula seminalis* form an interlacement on the vesicula, and some branches penetrate its substance. Other filaments from the prostatic nerves reach the same structure.

PROSTATIC PLEXUS.

Prostatic nerves;

This plexus is continued from the lower part of the pelvic plexus. The nerves are of considerable size, and pass onwards between the prostate and the levator ani. Some are furnished to the body (from which they are named), and to the vesicula seminalis; and the plexus is then continued forwards to supply the erectile substance of the penis, where its nerves are named "cavernous."

furnish cavernous nerves.

Cavernous nerves of the penis.*—These are very slender, and difficult to dissect. Continuing from the prostatic plexus, they pass onwards, from the fore part of the prostate gland, beneath the arch of the pubes, and through the muscular structure connected with the membranous part of the urethra, to the dorsum of the penis. At the anterior margin of the levator ani muscle some short filaments from the pudic nerve join the cavernous nerves. After distributing twigs to the fore part of the prostate, these nerves divide into branches for the erectile substance of the penis, as follows:—

Cavernous nerves: small

Small cavernous nerves (nervi cavernosi minores—Müller). which perforate the fibrous covering of the corpus cavernosum near the root of the penis, and end in the erectile substance.

and large:

The *large cavernous nerve* (n. cavernosus major), which extends forward on the dorsum of the penis, and dividing, gives filaments that penetrate the corpus cavernosum, and pass with or near the cavernous artery (art. profunda penis). As it continues onwards, this nerve joins with the dorsal branch of the pudic nerve about the middle of

* These nerves have been made the subject of a monograph by Professor Müller; it is entitled "Ueber die Organischen Nerven der erectilen männlichen Geschlechts-organe," &c. Berlin, 1836.

the penis, and is distributed to the corpus cavernosum. Branches from the foregoing nerves reach the corpus spongiosum urethræ. supply spongy bodies.

NERVES PECULIAR TO THE FEMALE.

NERVES OF THE OVARY.

The ovary is supplied chiefly from the plexus prolonged on the ovarian artery from the abdomen; but it receives another offset from the uterine nerves. Two sources.

VAGINAL PLEXUS.

The nerves furnished to the vagina leave the lower part of the pelvic plexus—that part with which the spinal nerves are more particularly combined. They are distributed to the vagina without previously entering into a plexiform arrangement; and they end in the erectile tissue on the lower and anterior part, and in the mucous membrane. Vaginal nerves: not plexiform.

NERVES OF THE UTERUS.

These nerves are given more immediately from the lateral fasciculus prolonged to the pelvic plexus from the hypogastric plexus, above the point of connection with the sacral nerves. Separating opposite the neck of the uterus, they are directed upwards with the blood-vessels along the side of this organ, between the layers of its broad ligament. The larger part of the nerves soon leave the vessels; and after dividing repeatedly, but without communicating with each other and without forming any gangliform enlargements, sink into the substance of the uterus, penetrating for the most part its neck and the lower part of its body. One branch, continuing directly from the common hypogastric plexus, reaches the body of the uterus above the rest; and a nerve from the same source ascends to the Fallopian tube. Lastly, the fundus of the uterus often receives a branch from the ovarian nerve.* (See Mr. Beck's paper, especially the plate marked 12.) Uterine nerves ascend with vessels at side of uterus. Some leave the vessels. Not ganglionic. Nerve of Fallopian tube.

* From the preceding statement it may be inferred that the uterus does not receive any considerable supply of nerves. It is necessary, however, to mention, that Dr. Robert Lee has described and given representations of a large additional system of uterine nerves not pre-

Others with the vessels are ganglionic.

Some very slender filaments are differently disposed from the preceding nerves: these form a plexus round the arteries, and terminate on or with those vessels. On the last-mentioned plexiform vascular branches minute ganglia are formed at intervals.

Do uterine nerves increase during pregnancy?

The *nerves of the gravid uterus.*—The recent dissections of Mr. Beck, if they are accurate, as they seem to be, prove that the nerves do not alter in their thickness during pregnancy, at least that no alteration occurs before they enter the tissue of the uterus; while that organ itself, and the vessels which supply it, undergo a remarkable augmentation in size.

Difference of opinion on this subject.

It is doubtless owing to the great difficulty of dissecting the uterine nerves,—mixed up as they are with arteries, veins, and lymphatics, together with laminated connective tissue,—and, as a result of this difficulty, to the want of adequate dissections, that anatomists have come to opposite conclusions respecting the state of the nerves in the circumstances indicated in the last paragraph: some, as William Hunter, Professor Tiedemann, and Dr. Lee, stating that the nerves are enlarged in the gravid uterus; while others, including John Hunter, maintained the opposite opinion. With respect to the researches of Mr. Beck referred to in the text:—the representations of the gravid uterus and of the unimpregnated uterus of a person who had borne children, which are contained in his paper, show the nerves to be of the same size in both cases: and the author (it is stated in a note, page 222) has ascertained by another dissection, that, in the virgin uterus, and in the same organ enlarged during gestation, no difference in thickness is perceptible between the nerves.

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viously noticed by any anatomist, at least not noticed as nervous structures; and the observations of this enquirer, if correct, would prove that the uterus is supplied with nerves in great abundance,—that it is in fact to a considerable extent covered with a stratum of nervous plexuses and ganglia.

The Editor has not embodied the statements peculiar to Dr. Lee with the account of the uterine nerves contained in this work, in consequence of having come to the conclusion, from his own examination of the subject, that Dr. Lee has been mistaken with respect to the nature of the structure he has been the first to describe as nerve—namely, the layer of fibres lying immediately under the peritoneum in the form of "a great web," and extending over a large part of the uterus.—For the details of the researches here adverted to, see "The Anatomy of the Nerves of the Uterus," by Robt. Lee, M.D. F.R.S., London, Baillière, 1841; and two papers by the same author in the "Philosophical Transactions" for 1842.—Note to the Fifth Edition.

END OF VOL. II.

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